JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

NOVEMBER, 1838.

Practical and Theoretical Mechanics and Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the liquefaction and solidification of Carbonic Acid.

By J. K. Mitchell, M. D.

In the year 1823 public attention was strongly drawn to the subject of the liquefaction by pressure, of the, so called, permanent gases, by Mr., now Sir Michael Faraday.* Among the ærial fluids, carbonic acid was distinguished as requiring a force of 36 atmospheres at 32° F. to coerce it into the liquid state. His ingenious and hazardous experiments were conducted in glass tubes; and he depended on the accumulation of newly generated gas for necessary pressure.

Mr. Brunel,† in a subsequent endeavour to apply compressed gases to mechanical purposes, produced a pint and a half of liquid carbonic acid, which, even at high temperatures, he confined in a series of small brass tubes not above the $\frac{1}{10}$ of an inch in the thickness of their walls.

This interesting subject was not again publicly agitated, until the appearance in December, 1835, of a report on the liquefaction of carbonic acid on a comparatively large scale. In the last number for that year of the *Annales de Chimie et de Physique*, M. Thillorier described the properties of liquid carbonic acid in detail. According to him this liquid demands for its existence as such at 32° F., a pressure, as stated by Sir M. Faraday, of 36 atmospheres. Its specific gravity is at the same temperature 0.830, at —4°F.—0.900, and at 86°—0.600. It is therefore enlarged by heat 3.407 times as much as its own or any other gas, when carried from 32° to 86°. From —4° to 32° its expansion is almost exactly equal to that of the gases.

M. Thillorier found also that the expansive force is altered by heat so as to amount at 86° to 73 atmospheres, and at —4° to 26 atmospheres. The density of the gas when resting over the liquid at 86°, is stated at 130 times the density of that which is compressed by the force of one atmosphere. Its pressure is therefore at 86° not much more than one-half of that which its density would indicate.

When liquid, the carbonic acid is, on the same authority, immiscible with

* Philos. Trans. Lond. † Quart. Journ. vol. XLI.

water and the fat oils, but is readily united with ether, alcohol, naphtha, oil of turpentine and carburet of sulphur. Although potassium decomposes it, lead, iron, copper, and the other easily oxidized metals, do not act on it.*

The theometric temperature observed in the jet by Thillorier, appears to be erroneously stated; for, as the *solid* is, at its formation, not below —90°, and as the act of solidification of any vapour or liquid keeps the temperature, for the time, at the highest point compatible with the existence of the particular solid under observation, it follows that the jet of carbonic acid cannot fall below its freezing point. Immediately after its production, the carbonic snow begins to grow colder, and may be made to reach —109° in the air, —136° under an exhausted receiver. When moistened with ether, it can be depressed to —146°. Professor Hare's ether acts much more effectually than sulphuric ether.

At the immediately subsequent sitting of the Academy of Sciences, Thillorier announced the important fact that he had solidified carbonic acid. This he effected by suffering the liquid to escape into a bottle, or box, where by the sudden gasefaction of a part, the remainder was frozen by the extreme cold thus produced. The solid is white, light, evaporable and excessively cold. Because, surrounded by an atmosphere of gas which is constantly escaping from it, a fragment of it touched lightly by the finger glides rapidly over a plane surface.

Its evaporation is so complete as to leave no other trace of moisture than that which is caused by the coldness and consequent atmospheric humectation.

The force of its gasefaction is alleged to be equal to, but not so sudden as, that of gunpowder.

The temperature at which the solidification took place was presumed to be about —148°F; although the experiments before the committee of the Academy shewed —124°.

Such is, in substance, the account by M. Thillorier of his novel and curious discovery, reported in the *Annales de Chimie*. No description of the method of procedure, or of the apparatus used, is annexed; and we are left to conjecture, and to the imperfect description of travellers, for any farther knowledge of either.

Having repeated the experiments of Thillorier, I deem it not useless to subjoin a draught of the instrument with which, aided by the suggestions of an intelligent pupil in France, and the assistance of friends here, I was enabled successfully to repeat most of the experiments of Thillorier and to verify some, and correct other, of his results.

The apparatus consists of a generator of cast iron, A, supported by a wooden stand, B, a receiver, F, also of cast iron, connected to the generator by a brass tube, and fastened firmly to it by the stirrup screw, K,—H, I, J, are stop-cocks, G the nozle of a pipe, L a glass level-gauge, and S, M, R, a pressure-gauge.

The generator is 20 inches long and 6 inches in diameter exteriorly. Its cavity is 16 inches deep, and 3 inches, nearly, in diameter, so that it will hold about 4 pints. The walls are, of course, about 1½ inches in thickness. At the top an aperture of two inches in diameter is closed by a strong wrought-iron screw, the shoulder of which is let in about a quarter of an inch. The

*Among the most remarkable of the phenomena observed by Thillorier was the intense cold produced by the sudden liberation of the liquid and its conversion into gas. A jet of it depressed the thermometer to —130F., and when sulphuric ether had been previously mixed with the liquefied gas, the refrigerating effects were more marked both on mercury and the sensations.

collar is of block tin turned to the size of the shoulder of the screw. There is a hole in the head of the screw E for the reception of a long, strong, iron bar.

The copper cup, N, 1¾ inches wide, and 9 inches long, holds about 12 fluid ounces. There is a little handle at the top, and a copper wire at the bottom which make the whole length a little less than that of the cavity of the generator. This cup is used to introduce the sulphuric acid.

The brass tube between the generator and receiver is divided into two parts of equal length, which admit of being united by means of a conical juncture, kept tight by the stirrup and screw, K, K. Each of these portions of the tube may be closed or opened at pleasure by a stop cock. One is placed at I, another at J; so that when the receiver is being separated from the generator, the contents of both may be retained. The stop-cocks in common use are inadequate to resist the pressure, and therefore a screw stop-cock is indispensable. It is made to close a small aperture by means of a conical point, and having a double cone, it closes an outlet also when the cock is completely open, so as to prevent the escape of gas by the sides of the screw.

The receiver, F, is of the capacity of about a pint. The pipe, G, G, turned at a right angle at G, descends so as almost to touch the bottom of the cavity in F. The stop-cock H, G, is similar to I and J. L is a glass tube connected at each end to a socket of brass, which communicates with the interior of F. It is the gauge for observing the level of the liquid in T.

The gauge for measuring the pressure is peculiar. Into a wrought iron box, S, are inserted, by screws, two sockets, T and U. The former descends almost to the bottom of the box, which is nearly filled with mercury. Through the axis of the screw, X, a small tube passes into the cavity of S, and is continued to the top of it, so as to rise above the mercury. Two strong barometer tubes, R and M, are cemented* into U and W, and hermetically sealed at the upper ends. These tubes are carefully graduated. In one of them, U, a short cylinder of mercury is made to stand at Y at the commencement of the experiment. The other, socket and all, is full of air, as no mercury is introduced into it. A very fine screw at W, enables the operator to regulate the quantity of air in T.

The tin cup, O, used to collect the solid acid, is covered by a lid, Z, perforated by a pipe, P, whose top is full of small holes. The handle Q, is hollow, so as to fit the end of the pipe of the receiver at G. To secure the hand of the operator from the cold produced by the experiment, the handle is carefully wrapped up in some kind of cloth.

The apparatus is prepared for use by removing the screw E, and placing 1¾ lbs. of bicarbonate of soda in the generator, A, to which 24 fluid ounces of water are to be added. After making these into a thin paste by stirring, nine fluid ounces of common sulphuric acid are to be poured into the copper cup, N, and that is to be let down by a crook of wire into the generator. After the screw, E, has been firmly applied, and the stop-cock, J, closed, the contents of the generator are to be brought into admixture by moving it round to a horizontal position on the swivel, D, which is supported by the

* The cement used was made of shell lac 3 or 4 parts, white or crude turpentine 1 part, melted at as low a temperature as possible so as not to make bubbles in the mixture. This cement is very strong, but liable, without great care in the regulation of the heat, to have capillary tubes in it from the vaporization of the turpentine. This defect may be completely corrected by cutting away, when cold, the external mass of cement, and putting on a little common cap cement which melts at a much lower temperature and closes the tubes.

wooden frame, B, B. There is a check bar at C. This motion is to be repeated several times. In about 10 minutes the whole of the carbonic acid is liberated, and exists in A, chiefly in a liquid state.

The next step in the process is to attach by means of the stirrup and screw, K, K, the receiver, F, *previously cooled by ice.* The keys, I and J, may then be opened slowly, and instantly the liquid carbonic acid is perceptible in the gauge, L. At the end of 10 minutes the communication with the generator may be cut off—when about eight fluid ounces of liquid acid at 32° F. will be found in the receiver.

By letting this liquid into the box, O, through the pipe, G, a large part of it is instantly expanded into gas, which escapes through the tube, P. The coldness consequent on the enormous expansion freezes another part of the liquid, which falls to the bottom of O. About one drachm of solid matter is thus formed for each ounce of liquid.

The porosity and volatile character of the solid renders its specific gravity of difficult ascertainment. When recently formed it is about the weight of carbonate of magnesia, and when strongly compressed by the fingers, its density is nearly doubled. Solid carbonic acid is of a perfect whiteness, and of a soft and spongy texture, very like slightly moistened and aggregated snow. It evaporates rapidly, becoming thereby colder and colder, but the coldness produced seems to steadily lessen the evaporation, so that the mass may be kept for some time. A quantity weighing 346 grains lost from 3 to 4 grains per minute at first, but did not entirely disappear for 3 hours and a half. The natural temperature was 76°—79°. The solid is most easily kept when compressed and rolled up in cotton or wool. Its temperature when newly formed is not exactly ascertainable because it is immediately lowered by evaporation. Thillorier seems to have entertained the opinion that the greatest degree of cold was created at the time of the formation of the solid. In my experiments a constant decrease of temperature was observed; which was accelerated by a current of air, or any other means of augmenting evaporation. At its formation, the carbonic snow depresses the thermometer to about —85°. If it be confined in wool or raw cotton, its cooling influence is retarded; if it be exposed to the air, especially when in motion, the thermometer descends much more rapidly; and under the receiver of an air pump, the effect is at its maximum. The greatest cold produced by the solid carbonic acid in the air was —109°, under an exhausted receiver —136°, the natural temperature being at +86°.

The admixture of sulphuric ether so as to produce the appearance of wet snow, increased the coldness, for the temperature then fell, under exhaustion, to —146°,* a degree of cold which we were not able to exceed by means of any variation of the experiment. That result is most easily obtained by putting about two fluid drachms of ether into the iron receiver before charging it. A compound liquid may be thus formed which yields a snow in less quantity, but of a more facile refrigeration. Alcohol may replace ether in either mode, but with less decided effect. In the air the alcoholic mixture fell to —106° and remained stationary. By blowing the breath on it, it fell to —110. Left to itself it rose slowly to —106°; but on being placed under an exhausted receiver fell to —134°.

Every attempt to wet the carbonic solid with water, failed, so that no estimate of its relative effects could be made.

The experiments resulting from the great coldness of the new solid, were

* As —146+32 = 178, the cold is nearly as far below the ice-point as 212 —32= 180 is above it.

very striking. Mercury placed in a cavity in it, and covered up with the same substance, was frozen in a few seconds. But the solidification of the mercury was almost instantly produced by pouring it into a paste made by the addition of a little ether. Frozen mercury is like lead, soft and easily cut. It is ductile, malleable, and insonorous. Just as it is about to melt, it becomes brittle or 'short' and breaks under the point of a knife. These facts may account for the discrepancies of authors on this subject. Frozen mercury sinks readily in liquid mercury.

At about —110° liquid *sulphurous acid* is frozen, and the ice sinks in its own liquid, and at —130° *alcohol* of .798, assumes a viscid and oily appearance, which by increase of cold, is augmented until at —146° *it is like melted wax*. Alcohol of 820 froze readily.

At —146° *sulphuric ether* is not in the slightest degree altered.

When a piece of solid carbonic acid is pressed against a living animal surface, it drives off the circulating fluids and produces a ghastly white spot. If held for 15 seconds it raises a blister, and if the application be continued for 2 minutes a deep white depression with an elevated margin is perceived; the part is killed, and a slough is in time the consequence. I have thus produced both blisters and sloughs, by means nearly as prompt as fire, but much less alarming to my patients.

The specific gravity of liquid carbonic acid may be estimated either by weighing a given measure of it in a tube, and deducting the weight of the tube, and of the superincumbent gas, or by means of very minute bulbs of glass as suggested by Sir M. Faraday. By the latter means I obtained the following results, which are compared with those of Thillorier.

		Thillorier.	
Temp. Fahr.	Sp. Gr.	Temp. Fahr.	Sp. Gr.
32°	.93	32°	.83
43°.5	.8825		
51°	.853		
74°	.7385		
86°		86°	.60

The specific gravity particularly at 32°, was examined repeatedly, and with different bulbs, and always found to be at, or very near, to .93. The difference never amounted to .005. The sp. gr. as given by Thillorier at 32° is 83. The anomalous expansion of the liquid as indicated by both sets of experiments is truly surprising. By mine 73.85 parts raised from 32° to 74°, or 42°, become 93 parts, and gain 19.15 parts, while the same bulk of the gases acquires in the same range of temperature only 6.46 parts, or the liquid is expanded very nearly three times as much as its own or any other gas. According to Thillorier, 60 parts gain 23 parts by an elevation of 54°, while the same bulk of air would under like circumstances be augmented only by 6.75 parts; or the liquid is nearly four times as expansive as the gases.

As below 32°, or at reduced pressures, the augmentation of temperature is productive of much less expansive influence, we may infer that under the weight of a few atmospheres, as when near to its freezing point, liquid carbonic acid is scarcely more dilatable by heat than water. Between —4° and +32°, its expansion is 0.053 while that of air is 0.069. These facts suggest the inquiry how far water at *very high temperature and pressure* may be obedient to the same expansive influence, and thus by suddenly filling the whole interior of a boiler, sometimes cause explosions.

The pressure of carbonic acid gas, when placed over its liquid, is given

by Thillorier at 32° and 86°, as 36 and 73 atmospheres respectively. By means of the gauge S, M, R,—I found the pressure as follows:

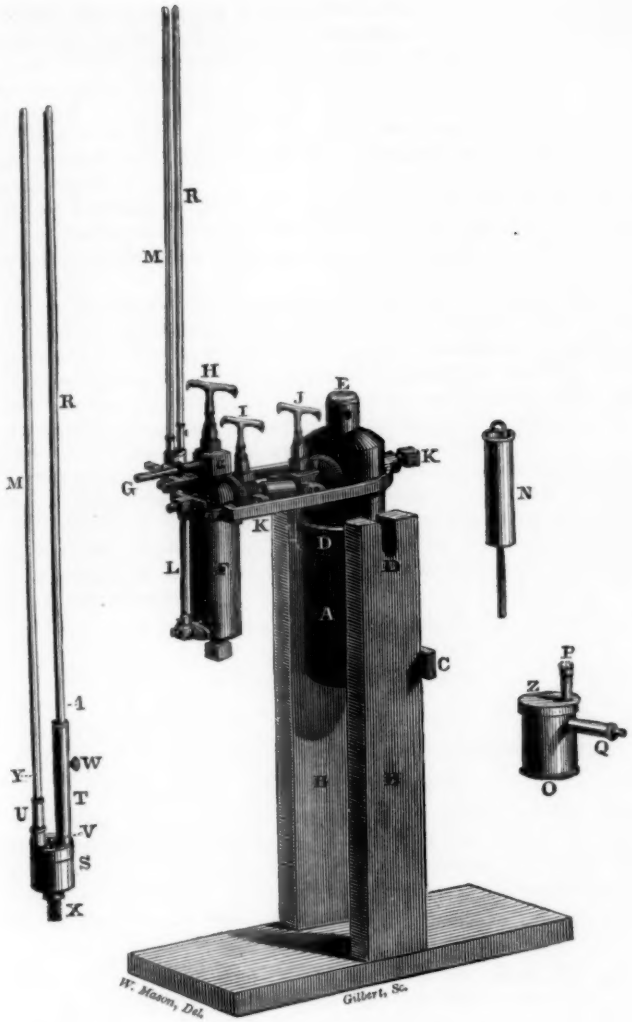
32°	36	atmospheres.
45°	45	do.
66°	60	do.
86°	72	do.

The principle of the gauge renders it capable of registering the pressure with great accuracy:—for as one tube, M, begins to mark the pressure from the commencement of an experiment, and the mercury in the other, R, does not reach a visible point until the first has shewn a pressure of several atmospheres, the second tube is equivalent in effect to one of several times its length. The first determines the amount of pressure, at which the mercury reaches the initial point on the 2nd, and the 2nd, subsequently, exhibits the multiplicators of that initial quantity. Thus, if when the mercury is at five atmospheres in M, it is at the unit mark in R, the value of that unit will be five, and the numbers representative of the pressure on R, must be multiplied by five; or R is equal in effect to a tube of five times its length. By these means very short tubes may be used to determine very high pressures. Inequalities in temperature, irregularities in the cement, and other causes, may vary the capacity of the socket T, W, but as M always signifies the unit for R, in each case, no error can arise from these causes. There must, of course, be a correction for the weight of the mercurial column in R, which is to be added to the product. Care must be taken to keep the temperature of the vessel which holds the liquid below that of the gauge and tubes, otherwise the liquid will be formed by condensation in the latter. This actually happened in the attempt to ascertain the pressure at 86°, when the natural temperature was 75°. Bubbles of gas were seen ascending through a liquid in M, up to its surface at a few inches below the mercurial cylinder. This as far as relates to the tubes may be avoided by prolonging the socket of M, down into the mercury of the cup, so as to include a cylinder of common air between two cylinders of mercury, and prevent any carbonic gas from entering either the socket, or the glass tube. A correction for the weight of this column, must in such case be made.

When a glass tube, hermetically sealed at one end, and cemented into a brass socket and screw at the other, is attached to a charged receiver and cooled by snow or pounded ice, liquid carbonic acid may be collected in it. It is perfectly colourless and transparent, and the specific gravity bulbs, previously introduced, are seen to ascend or descend, as the temperature is altered. When the tube so charged is opened, the liquid becomes violently agitated, escapes rapidly, grows colder and colder, and finally the remainder is converted into a solid, more dense than the snow already described, but nearly white, and very porous. If the tube be exposed to a paste of carbonic snow and ether, the liquid is solidified into a mass which is not porous but which sinks in the liquid as the latter is formed again by the melting of the solid.

The analogy between liquid carbonic acid and water, is thus completed for we have liquid, vapour, snow, and ice, exhibited by both.

By the previous introduction of water, ether, alcohol, metals, oxides, or oils, &c. into such tubes, and then filling them with liquid carbonic acid, the resulting phenomena may be easily observed. Water being heavier rests below the new liquid, and does not appear to mingle with it even at the surface of contact, for when the latter is let off, no bubbles appear in the water, and it is frozen at the top into a solid ice.


R
M
H
E
J
I
K
G
N
K
D
L
A
C
P
Z
Q
O
B
B
R
M
1
Y
W
T
U
V
S
X
W. Mason, Del.
Gilbert, Sc.

When alcohol or ether is introduced, the new liquid falls through it in streams, as water would do, but soon renders it milky by mixture. The removal of the pressure causes a violent effervescence, and immediately the clear, colourless ether, or alcohol, is seen alone in the tube; no solid being formed. When alcohol holds shell-lac in solution, the acid causes its precipitation in light whitish flocculi, which are immediately re-dissolved when the acid is suffered to fly off. Nothing remains but the brown lac-stained liquid.

Liquid carbonic acid did not appear to act on any of the metals or oxides, but the experiments on this point demand a further examination. Its inaction is probably owing to the want of the force of 'presence,' or of 'disposing affinity.'

When the liquid has been frozen in a tube of glass, the tube may be melted off by the blow pipe, and hermetically sealed. Such a tube will always retain the liquid, or gas, the former, if in sufficient quantity, at all temperatures, if not, the latter alone will be found in it at high temperatures. I have one such tube, which begins to shew moisture at 56°, and exhibits a constantly elongating cylinder of liquid, as the coldness is increased. At 32° the cylinder is about half an inch in length.

Carbonic acid mechanically powerful as it is, is not applicable, perhaps, either to locomotion or projection; but though the reasons for this are most of them obvious, the Franklin Institute has appointed a committee to investigate and report on the subject, that the exact truth may be known, and the waste of time and talent likely otherwise to be experienced, be saved to the country.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Cubes and Squares.

In reading the account, in the Journal for August, of Mr. Turner's theorem for finding the cubes by the addition of the groups of *odd* numbers, I was led to the consideration of cubes and squares, and made the following discoveries: at least they are discoveries to myself, as I know not that they have before been adverted to.

I. *For the Cube.*

Take the series of *even* numbers and divide them into groups of two, three, &c., terms consecutively, and put the figure denoting the number in each group at the top. The sum of each group, with the addition of the number denoting the group, (or, what is the same, the addition of the number of the figures in the group,) makes the *cube* of that number. As,

2		3			4				5				
2	4	6	8	10	12	14	16	18	20	22	24	26	28

The cube of 2 is $2+4+2 = 8$.
The cube of 3 is $6+8+10+3 = 27$.
The cube of 4 is $12+14+16+18+4 = 64$.
The cube of 5 is $20+22+24+26+28+5 = 125$.

II. *For the Square.*

Divide the natural numbers into groups,—not of one, two, three figures,

&c,—but of *even* consecutive numbers, groups of 2, 4, 6, 8, &c., and number the groups 1, 2, 3, 4, 5, &c. In the first group the first figure is the square of 1; in the second group the second figure is the square of 2; in the third group the third figure is the square of 3, &c.: As,

1 2 | 3 4 5 6 | 7 8 9 10 11 12 | 13 14 15 16 17 18 19 20

Or the squares may be found without groups, by the constant addition of 2, as follows. The square of 2, which is 4, is the *third* figure from 1, the first square: the distance of every subsequent square increases by 2: that is, the square of 3 is the *fifth* figure from 4, the square of 2; the square of 4 is the *seventh* figure from 9, the square of 3; the square of 5 is the *ninth* figure from 16 the square of 4, &c. Thus,

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
24 25

Having a series of natural numbers, the roots 1, 2, 3, &c., may thus be put over their squares. It may be seen, that the distance from 4 to 9 is 5 figures; from 9 to 16 is 7 figures; from 17 to 25 is 9 figures; and so on, increasing by 2.

Or the squares may be found as follows: Divide 1 from the other numbers; then for *even* roots take as many of the next even numbers as are equal to the root; and for *odd* roots take as many odd numbers as are equal to the root: the last figure of each group gives the square of the number of the group. As,

1 | 2 4 | 5 7 9 | 10 12 14 16 | 17 19 21 23 25 | 26 28 30 32 34 36

It is seen, that there is an alternation of groups of even and odd numbers. The omitted figures are less in number by one, than the number of each group.

The square of any number being known, the square of the next number *above* is ascertained by adding to the known square the sum of the two numbers. As, the square of 40 being 1600, the square of 41 is = 1600+40+41 = 1681.

Of course the square of the next number *below* the number, whose square is known, is ascertained by deducting the sum of the two numbers from the square: 1681 being known as the square of 41, subtract 41+40 from 1681, and it gives the square of 40=1600. W. A.

Mechanics' Register.

List of American Patents which issued in January, 1838.

With Remarks and Exemplications by the Editor.

1. For improvement in the *Loom for weaving knotted Counterpanes*, and other fabrics in which the woof is raised from the surface; Erastus B. Bigelow, West Boylston, Worcester county, Massachusetts, January 6.

The claims made are, "1st. Raising the knots which compose the figure, from the surface of the cloth, by a series of movable dents, or teeth, or

hooks. 2d. Supporting the woof during the operation of the movable dents, or teeth, or hooks; and thereby regulating the length of the knots by a bar, beam, or race piece, as described. 3d. Separating, or dividing asunder, the threads of the warp, by means of beveled pieces of metal on the sides of the movable dents, or hooks, or teeth, to prevent them catching into and breaking the threads. 4th. A toothed cylinder, or cylinders, acting on machinery intervening between them and the dents, or teeth, or hooks, successively to raise the knots which compose the figure. 5th. The application of a prism and pattern card to produce the variations in the pattern, or figure."

Accompanying the specification of this patent are five sheets of drawings, affording a clear view of the invention, of which no adequate idea can be furnished without such aid.

---

2. For a machine for *Crimping Leather for Boots;* Lucius Upham, Putney, Windham county, Vermont, January 9.

A common boot crimp is taken, and the back edge of it is cut away at the heel, and contiguous to it at the leg and foot, so as to admit three double blocks of about three inches long to occupy the place of the removed stuff; the pairs of blocks lay side by side, and are coupled together by wire staples, forming loops at their backs, each pair having two staples. Through each block passes a screw which is to bear on the back edge of the crimp, and when the leather is tacked on, it is to be strained by turning the screws. The claim is to "the application of the six blocks connected by staples, and moved by screws, in the manner before described; to move independently of each other, or simultaneously, as the leather may require."

---

3. For a machine for *Moulding, and off-bearing, Brick and Tile;* Loomis E. Ransom, Millport, Chemung county, New York, January 9.

The prepared clay is put into a hopper, or box, from whence it is forced into the moulds placed in front of the hopper, which is open for that purpose. The hopper, and the frame of this machine are so formed that the moulds when being filled, slope back at an angle of from five to ten degrees, giving them a tendency to fall towards the table in front, and preventing the clay from falling out. There are ribs in front of the hopper, so formed and placed as to divide the clay and conduct it into the moulds. The follower which fills the moulds works horizontally from the back of the machine, it rests on the bottom of the hopper, and slides in grooves, being operated on by a treadle. When the moulds are filled, strikers, formed of plates of metal, are brought down; there is one of these strikers to each brick, and it is guided by a rebate, or groove on the ribs. The lower ends of the strikers are sharp, and curved crosswise. The claims are:

"1st. The manner of conducting the ribs of the grating, and of arranging them as described.

"2d. The method of constructing the strikers as above described, with the lower ends curved forward, to prevent the clay adhering to the face of the strikers.

"3d. The arrangement of the inclined frame to give the moulds an inclining position forward, in order to cause the clay, by its gravity, to fall into the moulds after being cut, and to enable the operator to remove them with ease as above described."

4. For *Strengthening the axles of Rail Road Cars and Locomotives;* Ziba Durkee, Philadelphia, Pennsylvania, January 9.

Upon the middle of each axle there is placed an iron cylinder, having flanches rising from each of its ends, giving to it the general form of a common bobbin. These flanches are each to have holes through them to receive the ends of rods of iron, the other ends of which pass through iron plates placed on the face of each wheel, and surrounding the hubs; there may be four, or any preferred number, of such rods, which are to be drawn tight by nuts and screws. This, the patentee says, will "greatly strengthen the axle, and prevent it from breaking, and support the wheels should an axle break. With this attachment a smaller axle than those now in use will answer every purpose." The claim is to the above "mode of strengthening the wheels and axles of locomotives and rail road cars, by the combination of the cylinder, plates, and rods, constructed and connected substantially as within described."

---

5. For an improvement in the *Machine for breaking Flax and Hemp;* Andrew Forsyth, Columbia, Maury county, Tennessee, January 9.

This machine is constructed like the common hand break, but the slats forming the bed, are placed upon springs, that they may yield in some degree to the stroke. This constitutes the whole of the so called improvement, and is, of course, the only thing claimed.

---

6. For an improvement in the mode of *Attaching Springs to Carriages;* David A. Morton, Groton, Tompkins county, New York, January 9.

To the underside of the bottom of a carriage, are to be fixed cases, or tubes, running lengthwise, and near to each side. Within these cases there are to be spiral springs, wound so as to leave a space between each coil, to allow of their being drawn together. Rods passing through these springs have straps attached to them, which straps extend out at either end and wind round a cylinder fixed upon a shaft for that purpose. To the jacks by which the body is to be suspended are also attached straps which in like manner wind around cylinders upon the same shaft with the straps first named, but in a reverse direction. The straps which are attached to the springs pass over rollers at the ends of the spring case, to conduct them to the cylinders upon the shaft. Different modes of modifying these springs, straps, cylinders, and their appendages, are pointed out by the patentee; there may, for example, be but one spring case along the centre of the carriage body, or the spiral springs may be affixed without their being enclosed in a case.

The patentee says "it will appear obvious that when the body is thus suspended and the carriage is in operation, a portion of all the straps are alternately unrolling and rolling up on the cylinders. When the body settles, a portion of the straps attached to the springs are at the same time taken up, which will consequently contract the springs. When the body rises a portion of the straps attached to the jacks are taken up, and a portion of those attached to the springs are at the same time thrown off, which will necessarily elongate the springs."

"What I claim as my invention and desire to secure by letters patent, is the combination of the above described rollers, the straps, and the irons by

which the springs are contracted, with horizontal spiral springs attached to the under side of the carriage body as herein described."

There is certainly much ingenuity in the above described arrangement, and, so far as we know, it is essentially new; and we think also that these springs will operate pleasantly; the great objection to them is their liability to fracture, an accident of frequent occurrence in spiral springs similarly acted upon.

---

7. For a machine for *sowing Plaster, Ashes, and other separable substances;* Julius Natch, Great Bend, Susquehanna county, Pennsylvania; first patented August 17th, 1835. Surrendered and re-issued January 9.

This machine was noticed at p. 204, vol. XVII, but with a mistake in the name, the patentee being called Notch, instead of Natch; we there remarked upon the defectiveness of the specification, a fault which the new one is intended to cure. The following are the claims now made:

"The invention claimed by me the said Julius Natch, and which I desire to secure by letters patent, consists in the combination of the slide or agitator and hopper, as described, for agitating the substance in the same to be sown, so as to cause it to pass from the hopper regularly and evenly. I likewise claim the gauges for regulating the swinging parts of the hopper, whether constructed as herein set forth, or in any other manner substantially the same in principle."

---

8. For an improved *Machine for cutting Straw, and other substances;* Edwin Gillett, Ellington, Tolland county, Connecticut, Jan. 9.

In the general construction of this cutting machine there is not any thing new. The straw to be cut is placed in a trough, and is fed to the knife by a comb-like plate, denominated vibrating fingers. The knife is attached to a vibrating frame worked up and down by a crank, in the ordinary way. The things claimed are a "spring rest in front of the knife, in combination as described; and the method of feeding the vibrating fingers."

The spring rest consists of a bar of iron, or of steel, in front of the cutting box, and between which and the fore end of the box the knife is to pass; said spring rest having a yielding motion, for the purpose, it is said, of preventing the clogging of the machine. We have seen many similar machines work, but we never witnessed the necessity for such a contrivance, nor are we very certain that the proposed effects would be produced by it. A rod extending from the crank to the feeding comb, or vibrating fingers, is designed to give the required movements to that article.

---

9. For improvements in the mode of *Constructing and operating Churns, &c.;* S. P. W. Douglass, Lansingburgh, Rensellaer county, New York, January 9.

This patent is taken for a peculiar mode of giving to the dasher of the common vertical churn a rotary, as well as the ordinary vibrating motion, and the mode described of doing this forms the subject of the claim.

---

10. For an improvement in the *Machine for planing plank, boards, and clap-boards;* Barnabas Langdon, Troy, Rensellaer county, New York, January 9.

"The nature of my improvement consists in providing machinery, that in

its operation will produce an horizontal reverberatory movement by which the plank, or board, is driven in a lengthwise direction before a stationary plane stock set with cutters, so as to plane and smooth the plank, reducing it at the same time to the required uniform thickness; and also by providing an additional apparatus for the purpose of grooving, tongueing, and straightening its edges, all at one operation."

The claims made are to certain "grooves, or channels, in the faces of the plane stocks, with the arrangement of the cutters corresponding with the grooves, whereby the extra thickness of the plank is taken off, or reduced, with greater ease and effect. The particular arrangement and construction of the plates, or slides, to which the cutters are fastened. The clamps with the back plates for guiding the planks, or boards, and keeping them in a straight direction. The iron slides with their springs for supporting the plank in the operation of planing," &c.

The foregoing claim relates to certain particulars in the construction, which are represented in the drawing. The machine itself is of double the length of the stuff to be planed, so that for boards of eighteen feet in length, the bench would be upwards of thirty-six feet. Under the bench there is a rack, driven backward and forward by a pinion, with a reversing motion. The plank stands edgewise, between two cheeks, and from the upper side of the rack rise two drivers, which are to bear against the back end of the plank and force it forward. At each end of the bench there are sets of irons, or cutters, placed one behind the other, to cut the stuff in succession; these cutters operate like ordinary plane irons, and stand vertically. The devices for planing clapboards, &c. we shall not attempt to explain. To the machine, in its general construction, there is not any claim; we think, however, that it possesses sufficient novelty to have justified one, without limiting the claims to its individual appendages.

---

11. For improvements in the *Machine for shaving Shingles;* Barnabas Langdon, Troy, New York, January 9.

The claim is to "the slide with its seat or checks, for holding the shingle and giving it its proper taper; the manner of securing it in its bed by means of the clamps, and carrying it before the face of the plane, and also the general combination of the different parts," &c. These claims refer to the peculiarities of construction devised by the patentee; but the machine does not otherwise differ materially from such as have been previously made.

---

12. For an improvement on the *Planing Machine*, for which a patent was obtained August 28th, 1833; James McGregor, Wilton, Saratoga county, New York, January 9.

The original machine is noticed at p. 120, vol. XIII; the improvements now added have undoubtedly much enhanced its value. A good general idea of them may be obtained from the following claims:

"The first improvement which I claim consists in the new arrangement of the tongueing saws, namely, in the first jointing of one edge by a circular saw upon the first saw shaft, and the subsequent jointing of the opposite edge, whilst the edge first jointed is at the same time effected, at a point opposite, or nearly opposite to the second jointing saw. My second claim to improvement is to the employment of the gauge strip, in the manner and for the purpose set forth." There are some other claims, but from the nature of the machine a drawing would be required to make them understood.

13. For improvements in *Locomotives and Rail Road Cars;* Jonas P. Fairlamb and L. C. Judson, city of Philadelphia, January 9.

CLAIM.—"What we claim as our invention and desire to secure by letters patent is the construction and application of the *cylinder bunts*, to graduate the concussion of two bodies coming in contact. The construction and application of the *safety guard clamps* to wheels, to avoid danger when an axle breaks. The application of *small truck wheels* to guard against danger when a large wheel breaks. The *spring lever*, and mode and manner of guiding cars from one track of railway to another without the use of switches; and the construction and application of the *double universal joint*, each part as specified and described."

What the patentees call cylinder bunts is a new form of buffing apparatus, to ease off the blow when two cars, &c., come into collision. It is proposed to have strong metallic cylinders bored out in the manner of cannon, and into these to fit pistons, with rods projecting out, and covered with some elastic material, to receive the blow; within the cylinders are to be placed spiral springs; but the principal dependance is upon the elasticity of the air, re-acting upon the piston. "It is believed that with four such cylinders of twelve inch calibre, eight feet in length, two inches thick, of sound cast iron, well hooped with first rate wrought iron upon each, two locomotives may meet when going at the rate of thirty miles an hour without sustaining any damage." *Credat Judaeus.*

The safety guard clamps are to extend over each wheel, and come nearly in contact with the hub on each side, so that in case of the breaking of an axle, they shall form bearings by being brought into actual contact.

The spring-lever, which is to be a substitute for switches, is to be attached to the frame of each set of wheels of an eight wheel car in such a manner as that by pressing upon them they shall direct the cars; how this is to be effected is by no means clearly made known.

The double universal joint is to connect cars together, and to be used in lieu of the devices now employed.

---

14. For *apparatus for leaching Ashes*; Elijah Williams, Westfield, Chautauque county, New York, January 9.

This patent is taken for a particular mode of constructing the apparatus for leaching ashes; the claims made being to "the use of a boiler like that described, furnished with a safety tube, for the purposes set forth."

The ashes are to be boiled, and afterwards strained, in the apparatus described, the superiority of which over the means in ordinary use is not very apparent; the organ of novelty is very small, that of utility we have not been able to discover.

---

15. For an improved *Canal Boat;* Edward Randolph, Salt Creek, Muskingum county, Ohio, January 9.

This is a contrivance which differs but little from some that have preceded it, but still sufficiently to obtain the grant of a patent. The boat is to be of the twin kind, with a paddle wheel in the centre. The principal dependence for its utility is upon its leaving the waters unagitated by the aid of a fender board, and a smoothing board, which are thus claimed. "What I claim as my invention, and desire to secure by letters patent, is the way

the wheel is hung in a square trunk formed by the fender board under the wheel; and also the smoothing board hung behind the wheel, so as to discharge the water without doing any injury to the banks of the canal."

Methods very similar have been before essayed, but the great difficulty in attaining this long sought end has not been removed, and from the obstinacy of its character is likely always to remain in full force. Canal boats will displace a portion of water equal in weight to themselves, and to that of their load, and this must be constantly flowing back as the boat advances in order that the cavity may be filled, which must otherwise be left at her stern This is in conformity to a law of nature which has existed throughout all time, and one which nature alone can repeal.

---

16. For an *Apparatus for Steaming, Boiling, &c.;* B. F. Gold, city of New York, January 9.

This contrivance is merely a double cover of tin, enclosing air between the two laminæ, and to be placed like a dish cover, over articles to be boiled, &c. The claim is to this contrivance.

---

17. For improvements in *Scales, Beams and Weights;* Alvah N. Free, city of Troy, New York, January 9.

The claim made is to "the making the upper edge of the scale beam on which the poise, or weight, hangs, smooth and even, and combining therewith a poise having a pointer, or pointers, as described." The beam is divided on the side in the usual manner of steelyards, and a pointer rising from the top of the poise indicates the weight of the article weighed, by the divisions and the respective figures marked on the beam.

---

18. For a *Machine for washing and pulverizing potatoes in the manufacture of Starch;* Sylvanus Richardson, Jerico, Chittenden county, Vermont, January 9.

This is an apparatus in which a revolving shaft, furnished with arms set obliquely, operates upon the potatoes within a circular trough kept filled with flowing water; they are conducted into a hopper, by the action of the apparatus, and from the hopper pass under a grating cylinder; they then drop between rolling cylinders, by which they are reduced to a complete pulp, and are thus prepared for the making of starch from them. The individual parts of the apparatus are not claimed, but the inventor says that he is "not aware that the trough for washing, with its appendages, and the graters and rollers in their present arrangement, and for the uses and purposes set forth, have ever been before so used. He therefore claims as his invention the washing trough and its appendages in combination with the grater and rollers, in their arrangement and combination as described, for the uses and purposes herein before described."

---

19. For an improvement in his *Patent Lamp, and in other analogous Lamps;* Samuel Rust, city of New York, January 9.

This improvement consists in the manner in which a shade is added to the lamps previously patented by Mr. Rust; the roller for raising the wick; its connexion with the stopple and tube being the same as formerly.

20. For applying a shade to the *Lamps* formerly patented; Samuel Rust, city of New York, January 9.

This patent, as will be seen by the title, is for a purpose similar to the former, the mode of fixing and arranging being sufficiently different, however, to induce the taking of a separate patent.

---

21. For a *Cooking Stove;* E. L. Parshley and B. Furbish, Brunswick, Cumberland county, Maine, January 9.

The difference between this and several other stoves, is very slight. The claim is to "the particular mode of arranging the plates for conducting the draught down behind the fire, under, and up at the back of, and then over, the oven, to the front thereof, and thence back under the boiler, or boilers, to the escape flue at the back of the stove." The apparent novelty is the insertion of a plate between the top plate of the oven and the top plate of the stove, reaching entirely back to the back plate, so as to bring the draft to the front from the back, and carry it thence back to the smoke pipe at the rear end of the stove.

---

22. For improvements in the *Machine for rubbing and hulling Rice and other grain;* Alfred and William J. Duvall, city of Baltimore, January 9.

A hollow cylinder is to be made of cast-iron, which is to be formed of staves, and hooped together. Within this is to be placed a cylinder which is to revolve within it, having a space of two or three inches between the two. The outer cylinder, which is to be stationary, has teeth, or short arms, projecting inward, and the inner cylinder has corresponding teeth projecting outwards, which pass between the former. The grain is admitted through openings in the head of the machine, and discharged at its lower end. The claim is to "the mode of constructing the cylinder and runner with teeth passing between each other in the manner described." Machines for the same purpose, and consisting of one vertical cylinder revolving within another, and armed with teeth, have been long in use; the teeth, however, have been generally such as to operate like graters, whilst those used in the present machine act as stirrers and agitators; our impression is that if all the models formerly existing in the office were still there, some having a near approach to this would be found.

---

23. For a *Spherometer for ascertaining the relative Bearing of Places;* Cephas Johnson, Southington, Hartford county, Connecticut, January 9.

The claims made are to the manner of combining together the several graduated plates, and arcs of circles adopted by the patentee. "namely, the compass, divided into two separate parts, set vertically on the opposite side of a circle, having the eastern points on one part, and the western points on the other part; the part on which the western points are marked standing on the eastern side, and that on which the eastern points are marked standing on the western side of the instruments. The prime vertical in the form of a semicircle attached to the compass plates, turning on its ends to correspond with said plates, beviled on the inner edge, graduated for measuring geographical miles, and having shoulders projecting to indicate the point of the compass. The movable meridian in the form of a semicircle,

beviled on both edges, intersecting at once the prime vertical and equinoctial circle, and turning on pivots at the ends; the sliding meridian moving horizontally around a circular plate; the equinoctial circle set vertically, beviled on its circular edge, and graduated on both bevils, commencing at opposite ends on each bevil; the junction of the equinoctial circle at its base with a circular plate; all combined and made to move in the manner set forth; to produce, and, by such combination and movements of the movable parts, producing the effect of ascertaining the relative bearings of places, directing a ship by the shortest course from one place to another, running lines, and determining true distances."

After this imposing array of claims it will not be expected that we shall undertake to describe, and discuss, the merits of an instrument consisting of so many parts. We are apprehensive that this, like many similar instruments, will serve better to display the skill of the contriver, than to fill his pockets by coming into extensive use.

---

24. For an improvement in *Carriage Springs;* William Patton, Towanda, Bedford county, Pennsylvania, January 9.

There have been several patents issed within a few months for various modes of constructing springs for carriages; most of them are contrivances of little or no value; in many instances they bear so close a resemblance to each other as to show that they are the results of imitation; a fact which would be still more strikingly exemplified were we to publish the applications for similar patents which have been rejected. Where patents have been granted, the things claimed have, of course, been supposed to possess some novelty, whatever doubt may have existed respecting their utility.

The claim in the patent before us, is to "the adding to, and combining with, the semi-eliptical, or cradle spring, straight bars, cross beams, double bows, or projecting standards, one or more flat spiral springs, constructed as described." The spiral springs are placed, and operate, between the upper and lower springs, in a manner differing but little from those patented by William Croasdale, the specification of which will be found at p. 235, vol. xx.

---

25. For improvements in the *Machine for Mortising and Dovetailing;* John Brainard, Aurora, Portage county, Ohio, January 9.

In this machine the mortising chisel is worked up and down by a toggle joint, to one of the bars of which a handle is affixed, which projects out like a pump handle; the stuff is placed on a bed, and otherwise managed in the ordinary way. As respects dovetailing, there is little probability of the machine ever being used for this purpose, as there is no particular provision adapting it to this object, the stuff to be dovetailed being placed upon the bed, and moved by hand so as for the chisel to cut as it does in mortising. The claim is to "the combination of the toggle joint, handle, and chisel stock, applied to mortising and dovetailing, as described."

---

26. For an improvement in the mode of *Hanging Doors, to prevent rain from being forced under them by Wind, &c.;* Edmund C. Tilson, Thomaston, Lincoln county, Maine, January 9.

The claim is to the "letting a door down an offset in the threshold when

shut, to prevent the rain from driving under the door into the building: and the method of raising the door so as to swing over the stool, and of sustaining it at pleasure when closed, as described."

The inventor says, "my invention consists in making a perpendicular offset in the doorstool, or threshold, of about half an inch below the level of the highest part of the stool, so that the door when closed may be let down, or if not obstructed will slip down of itself, the depth of the offset, leaving the top ridge of the stool elevated thus much above the bottom of the door on the inside, but not on the outside; and in placing over the door, within or behind the inside casing, a lever moving on a pivot, midway from the short end of which a rod is let down connected by a spur with the heel of the door, so as to raise it when a power is applied to the other end of the lever, which is done by letting down a rod from that end also, with a small chain at the lower end to wind it on the windlass in the wall by a knob or crank on the outside of the casing. And also in making an offsett in the eye, or joint of the door hinge, so that one leaf of the hinge may slide down on the connecting wire, half an inch below the other when the door is shut; and placing a slide in the jamb casing at the heel of the door, to slide under the door to keep it up to its swinging level in fair weather, or when there is no occasion for letting it down."

Both ingenuity and skill are displayed in the contrivance alluded to, but there are others which have been devised, consisting of fewer parts, which have nevertheless been abandoned on account of their complexity and liability to derangement.

---

27. For improvements in the *Machine for Boring Framing Timber;* Jared Badger, Brooklyn, Windham county, Connecticut, January 20.

This machine is constructed so that its frame may be moved along, and affixed to the timber to be bored, preparatory to its being mortised. By turning a winch, two vertical shafts geared into each other, and carrying augers at their lower ends, are made to revolve. Such a machine may be modified in so many ways as to render it difficult, if not impossible, to construct one which will secure any available right to its inventor, as the claim must necessarily be confined to special contrivances, which admit of the substitution of others equally efficient. In the present case the claims are confined to "the mode of regulating the auger, or augers, crosswise of the timber, by means of slides at the top and bottom of the box, or carriage, as described.

---

28. For a *Machine for Sowing or Planting Ruta Baga, and other seeds or grain;* Hiram R. Merchant, Guilford, Chenango county, New York, January 20.

This resembles many other planting machines, as, indeed must necessarily be the case where contrivances for the purpose have been so numerous. It has two handles, and a single wheel, which rolls on the ground like that of a wheelbarrow. The hopper which is to contain the seed, is placed in advance of the wheel, and has in front of it a share for making a furrow into which the seed is to be dropped, and behind it two scrapers to close the ground over the seed, after which follows the wheel, or roller. The claim is to the mode of "construction, in placing the hopper forward of the

wheel, causing the wheel to answer the double purpose of wheel and roller; also, the manner of moving the slide, and scraping the dirt from the wheel."

---

29. For improvements in the art of *Measuring and Cutting Garments;* William and Charles Kahlen, Bloomsburg, Columbia county, Pennsylvania, January 20.

The specification of this patent is a little MS. volume of diagrams and description, consisting of about twenty pages. We have so frequently confessed our lack of learning in the mathematics of tailoring, as to render unnecessary any excuse for not, on the present occasion, offering a review of the treatise before us. The authors have not furnished any summary of its contents in the form of a claim, this being diffused over the whole work, and the system, in its general features, being considered as essentially new.

---

30. For improvements in the *Common, and Power, Loom;* Benjamin Lapham, Waterford, Saratoga county, New York, January 20.

"The nature of my invention consists in employing a spring to move the *wagstaff* in throwing the shuttle, and of dispensing with the ordinary *picker, picker strings* and *picker rods*, commonly used in the power loom; which I effect by straining a spring gradually during a full revolution of the cam shaft, by which the necessary force to throw the shuttle is acquired by an easy and uniform resistance to the driving power, exerting that force, always certain, under any speed of the loom."

"What I claim as new, and desire to secure by Letters Patent, is the manner of applying the principle of gradually accumulating a deposit of power to throw the shuttle, whether it be by the use of straining a spring or by raising a weight, as herein described. And secondly, the particular device specified, taken and considered as a combination of old methods to produce a new result."

---

31. For an improvement in the *Furnaces for Stoves* for burning anthracite; Eben Eaton, city of Troy, N. York, January 20.

This stove is to have mica sash on each of its sides, the cast iron plates being as entirely composed of open work as is compatible with its construction. The grate which is to contain the fuel is a kind of basket grate, composed of fine separate pieces, which when properly combined, form a hollow cylinder intended to revolve on an axis, with which it is provided for that purpose; the particular manner of forming this grate is set forth in the specification, and the claim made is to "the furnace constructed, substantially in the form above described, or with such variations only as will not alter its character, or mode of operation.

---

32. For a machine for *Trashing Grain and Shelling Corn*; Myron T. Gilbert, city of Troy, New York, January 20.

This machine is a combination of the ordinary thrashing machine, with its toothed cylinder and concave, and of that kind of corn shelling machine in

which a revolving plate is used, set with teeth. The shelling plate, or disk, constitutes one end of the thrashing cylinder, and the corn to be shelled is fed in at one side of the machine in the usual way. There is a shelling plate forming a segment of a circle, say one third, which is of cast iron, and has teeth on it like those of the revolving disk, opposite to which it is placed so that the ears fed in shall pass between them. The claim is to "the mode of constructing the thrashing cylinder and shelling wheel, as before described, being cast in one piece. And the combination and arrangement of the thrashing cylinder and concave with the shelling wheel and segment plate in one frame, for thrashing grain and shelling corn at one operation.

---

33. For improvements in the *Apparatus for Diving*; William H. Taylor, city of New York, January 20.

This diving dress is in most points like several others in its general aspect and construction; the principal improvement consisting in the employment of a larger portion than usual of metallic cylinders, in combination with the flexible water proof material, the more effectually to protect the limbs and other parts from injury. The claims are "*first*, the peculiar construction of the body piece, with its appurtenances of the pipes and chambers, as described. *Secondly*, the joint of the arms and legs, as made of spiral or circular wires, or hoops, covered with india rubber cloth, or other substance impermeable to water. *Thirdly*, the mode in which water proof covering, constituting part of the joints, is connected and secured to the cylindrical pieces of the arms and legs, by means of flanches upon said pieces, and a seizing of copper wire, or other fastening."

There is a pipe for conveying air down by means of a force pump, and another pipe from which the air respired is discharged. We cannot pretend to run a parallel between this and the numerous other similar apparatus of which we have some knowledge, not having seen a practical trial of the others; but on a late visit to New York, the above described machine was in actual use; the diver remained under water for about three-fourths of an hour, suffering, apparently, but little inconvenience during that time; he moved about with perfect facility, and passed into water of different depths sending up various articles from the bottom. We know that in all this there was not any thing of actual novelty, but it is mentioned because it tested the particular apparatus of which we have been speaking, and so far as the trial went it was perfectly satisfactory.

---

34. For an improved *Cooking Stove;* Horace V. Teall, Canajoharie, Montgomery county, New York, January 20.

There is no very characteristic feature in this stove; the claim is to "the construction of a partition enclosing the two large holes for boilers, with the valves, or dampers," which we do not think it worth while to describe.

---

35. For improvements in the construction of *Bee Houses and Bee Hives*, and the arrangement thereof; John Searle, Franklin, Merrimack county, New Hampshire, January 20.

The specification of this patent contains a system of management, and

a plan for the construction of the houses of bees, much in detail, and accompanied by various graphic illustrations. The claims made are to the construction of a spout, a balcony and its appendages, a ventilator, a feeder, a double top to the hive, and a cement floor to the house; all of which are fully described, and in a manner evincing a knowledge of the subject. The whole, however, is too intricate for a brief description.

---

36. For an improved *Corset Truss for Ruptures;* John Oberhauser, city of Charleston, South Carolina, January 20.

The claims under this patent are to "the construction of a corset truss, under its various modifications as described; which shall sustain the muscles of the abdomen by the action of the steel spring, or springs, which surround the body, as contradistinguished from the support by bandages which have been frequently resorted to, which springs are widened out by stiff plates, capable of receiving and applying two or more pads to the ruptured parts, in the manner set forth."

A general idea of the mode of construction may be formed from the foregoing claims; this system of forming trusses, like most others, will afford advantages in certain cases, but it still presents but little of peculiarity, or of addition to the resources of the surgeon.

---

37. For a machine for *Cutting Heading for Casks;* Lee Wells, Hartsville, Onondaga county, New York, January 20.

This is said to be an improvement on George Parke's machine, to which we shall not take time to refer. The heading, it appears, is to be cut by a knife, and the claim is to "the construction of the knife gate, as described," which description is not very luminous.

---

38. For an improvement in the *Horizontal Wind Mill;* William L. Thomas, and J. Lewis, city of Boston, January 27.

The claim made in this horizontal wind mill is to "the manner in which the opening and closing of the wings is effected, as described." The wings are represented as in the same shape with those of the ordinary vertical sails; the devices used for turning the sails consist in causing their inner ends to be acted upon by what is called a double inclined plane, the inclination of which causes them alternately to present their edges and sides to the wind. To lessen the friction incident to this mode of turning them by the inclined guide piece, friction rollers are used. At their outer extremities the sails are braced together, so as to give them the requisite stability.

We very much doubt the success of this plan, and apprehend that it will not be found equal to the ordinary mill with vertical sails. The mode of turning the sails will produce considerable and constant friction, in spite of the friction wheels, and will, we apprehend, be very liable to derangement from this cause.

---

39. For a machine for *Heading Spikes and Nails;* Reneer Dare, Bridgeton, Cumberland county, New Jersey, January 27.

The pieces of nail rod, cut into lengths, are to be pointed by the hammer

in the ordinary way. The heading machine has two jaws, operating like those of the blacksmith's vice, and in these are fixed dies adapted to the shank of the nail or spike, which is to be placed in them, and the head formed by a hammer. The jaws are opened and closed, and the nail inserted and discharged in a manner described in the specification, and the claim is to "the method of holding up and discharging the nail or spike in the dies, for the formation of the head, and upset of the same." We are somewhat at a loss to discover the real value of the machine, as it seems to us that some of those which perform the whole operation of spike making, do it effectually, producing good work with much greater rapidity than can possibly be done with that before us.

---

40. For a *Spark Extinguisher*, for Locomotives, &c.; Timothy Newhall, jr. Lynn, Essex county, Massachusetts, January 27.

The sparks are to be carried into the chimney, through a tube which is recurved after it enters it, so as to have its mouth downwards. Below this opening there is a box, or trough, to contain water, into which the sparks are to be driven by the force of the draught. To prevent the waste of water, and the return of the sparks, the mouth of the tube above spoken of, is furnished with what is called a conical funnel, and upon this, it appears, the utility of the apparatus depends. It is obscurely explained, and we really do not understand in what way it is to produce the contemplated effect; with the claim, therefore we dismiss the matter.

"What I claim as my invention, and desire to secure by Letters Patent, is the manner of applying the conical funnel for the purpose of preventing the waste of water; and this I claim in combination with the other parts of the apparatus with which it is connected, substantially in the manner set forth."

---

41. For improvements in the *Machine for Cutting Lagging;* Benjamin B. Slade, Smithfield, Providence county, Rhode Island, January 27.

The stoves, or slats, which constitute the peripheries of the drums, or cylinders, used in cotton, or other, factories, is denominated lagging, and the undersides of these are to be cut concave in a degree corresponding with the size of the drum, or cylinder, of which they are to constitute a part. The intention of this machine is to cut every required size of curve by means of the same rotary cutters, which are affixed to the periphery of a revolving wheel, and cut crosswise of the stuff. It will be manifest that if such wheel is of the size due to the smallest curve, by passing the lagging over it, at right angles with its plane, the desired curve will be obtained; that if the cutters project over the edge of such wheel, and the stuff be passed over its face, the cutters would traverse its surface, and cut, or plane it flat; and it will be equally manifest that by presenting the lagging at the various inclinations between these two, every intermediate curvature will be obtained; this is the principle of action, and the following is the claim.

"What I claim as my own invention and desire to secure by letters patent is the platform hanging on swivels, and the slide gauge on the top of said platform, in combination with the rotary cutters; the whole constituting a *lagging machine* for cutting different sized circles with the same cutters, all constructed substantially as above described."

42. For a machine for *cutting or mincing Vegetables, Meat, and other substances;* John G. Conser, Rebersburg, Centre county, Pennsylvania, January 27.

This machine consists of a cylinder having knives set round its periphery, and revolving horizontally in a hollow cylinder, or concave, furnished with similar knives. These knives are placed obliquely, so as to give to the articles operated on, a progressive motion from the feeding towards the discharging end. The feeding is performed by means of a hopper on the upper side of the cylinder, at one of its ends. The claim is to "the arrangement of the knives, or cutters, on the cylinder, as before described; but no other part of the machine is claimed."

Specifications of American Patents.

Specification of a patent for an improved Parlour Stove; granted to Jordan L. Mott, *city of New York, December 7th,* 1837.

To all whom it may concern, be it known, that I, Jordan L. Mott, of the city of New York, have invented an improved parlour stove, which is furnished with air-heaters, so constructed as to economize fuel, and to supply air of genial warmth, which is not deteriorated in its passage through the heating flues. And I do hereby declare that the following is a full and exact description thereof.

Fig. 1.

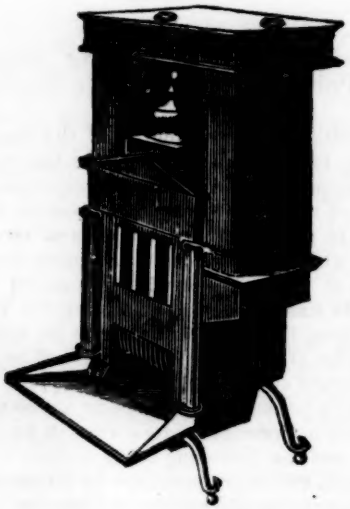


Fig. 2.

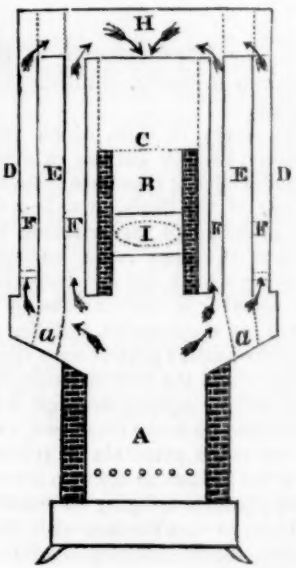


Fig. 3.

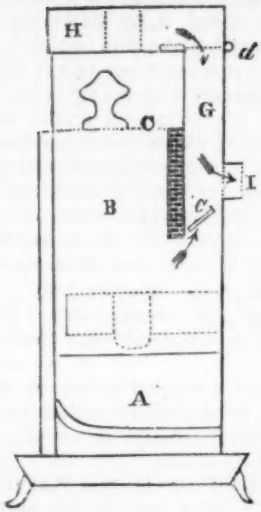


Fig. 5.

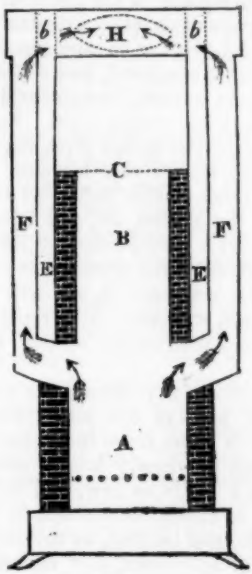


Fig. 4.

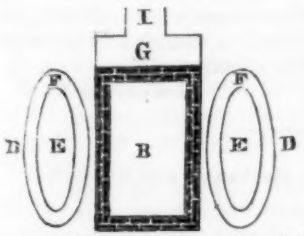


Fig. 1. in the accompanying drawing, is a perspective view of the stove. Fig. 2, is a vertical section through the middle thereof, parallel with its front; and Fig. 3, is a vertical section from front to back, through the middle.

In each of the figures, like parts are designated by the same letters of reference.

A, is the grate, or fire chamber, which is surmounted by B, a reservoir for coal, which has a close fitting cover at C, allowing a considerable quantity of fuel to be supplied at once, and to burn out gradually. D, D, are the combined flues, and air heaters, consisting of one cylinder, or rather oval tube, or chamber, within another, the innermost being the air chamber, and the space between it and the outermost the smoke flue. E, E, Fig. 2, &c., are sections of the inner or air, flues, and F, F, the spaces surrounding them, and forming the smoke flues. Air is admitted into the interior, or air, flue, at its lower end, through tubes, or apertures, leading into it, in any convenient way, as at the part represented by the dotted lines *a*, *a*; these tubes, or apertures, may be extended, if preferred, so as to admit air from without the room, but this will seldom be found necessary. The air which is heated in passing through these tubes, escapes into the room through openings at *b*, *b*, in the top of the stove.

The direction of the draught, or passage, for smoke and heated air, from the fires, is represented by arrows. There are, as in many other stoves, two directions for the escape of the smoke, &c., one directly to the escape pipe, and the other by a more circuitous route, which is to be used after

the fuel has become perfectly ignited. There is a flat flue, G, extending up from the fire-place to the chamber H, at the top of the stove; in this flat flue, there are two valves, or dampers, *c*, and *d*, by which the draught is governed. L, is the escape pipe for smoke, and into which it passes directly, when *c* is opened, and *d* closed; but when these valves are reversed, the draught is carried through the flues surrounding the air-tubes, and down the flue G, to the escape pipe. Fig. 4, is a horizontal section of the stove at the level of the escape pipe, the parts of which figure are designated by their proper letters of reference. By this arrangement of the flues, and of the air-tubes within them, the exterior, or shell, of the stove is directly heated by the heated air, and a free radiation takes place into the room. Fig. 5, shows a modification of this stove, in which the smoke flues do not entirely surround the air-flues, the latter being heated directly, on the side towards the reservoir B, but still through the intermedium of the brick lining, which, wherever it is represented, is coloured red. In other respects, the construction of this stove is identical with that before described.

Having thus fully shown the manner in which I construct and arrange the several parts of this stove, it is to be distinctly understood that I do not intend to claim these individual parts, generally, as my invention, they having been previously known and used.

All that I claim as new, and for which I ask Letters Patent, is the air chambers, or tubes, surrounded in whole, or in part, by the smoke flues, in the manner, and located, as herein described, in combination with the side openings, or apertures, that connect the smoke flue F, F, with the fire-chamber, whether said openings be under, or above, the surface of the fuel; and this I claim whether combined with a stove, such as that herein represented, or with one of any other construction, to which such side flues, so arranged and combined, can be advantageously appended. It being further understood that I make no claim to air-tubes surrounded by the smoke flues, when placed immediately above the fire chamber.

JORDAN L. MOTT.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the fallacies of the Rotary Steam Engine; by JOHN SCOTT RUSSELL, Esq., M. A., F. R. S., Ed.

The principles of the Rotary Steam Engine have been frequently adverted to in this Journal, and opinions indicating a want of confidence in them, (v. particularly Vol. XVII, p. 173) freely expressed by the editor. The Engine still continues to maintain its ground, and its claims to be put forth as a construction, preferable, especially for light work, in point of cheapness and efficiency, to that of the reciprocating engine. The motives for its adoption, with those who attempt to theorize upon it, are to get clear of the *loss of power* occasioned by the use of the crank and by the constant check which the piston undergoes from the necessity of its reverse or reciprocating movement. On these two points there have been much philosophical discussion, and much laboured and learned and unlearned disputation. Avery's Rotary Engine has been lately introduced into Scotland and its capacities highly extolled in some of the Journals. This has called forth several

learned papers in opposition to the objections to the reciprocating engine,—unfavorable to the rotary principle, and explanatory of the true doctrines of motive power and mechanical action.

The writer of the paper, an abstract of which is here given, enters with learning and research upon this interesting topic. His essay may be found at length in Jameson's Journal, vol. XXIV, p. 35, and an abridgement of it in the London Mechanics' Magazine, No. 776, p. 192. G.

Mr. Russel states:—"I have had the opportunity of examining and working the most successful engines of this kind ever produced, and therefore conclude that, had theory never led me to any such result *a priori*, I must have been convinced that practical experience was opposed to the rotary construction of the steam-engine. In what follows I shall endeavor to adduce my arguments in a form as little technical, as is consistent with precision.

1. It is first of all my wish to show that the subject of the rotary steam-engine is *not so new and untried* an invention as some who attempt the problem for the first time may be led to imagine;—for this purpose I adduce the names of more than ninety inventors, most of them patentees.

2. By an arrangement of these inventions, I have endeavored to show that *five different classes comprehend them all*, and that the others are mere repetitions of the same principle, and attended with the same failure; so that an inventor may know whether his invention contains an entirely new principle, and if it do not, that it has been already tried and failed.

3. By showing in one view, the names of inventors of unsuccessful rotary engines, I endeavor to convince the inventor that five classes already invented have *not failed from want of genius, skill, or practical experience*, in those who have made the trial, for the list contains the names of eminent practical men.

4. I endeavor to show that the *ordinary crank engine does not possess the defects attributed to it*, and which it is the sole object of the rotary engine to remedy,—that the use of the crank causes no loss of power.

5. In a practical point of view, the *rotary engine is every way inferior* to the reciprocating engine;—in simplicity, and cheapness, and ease of construction,—in durability and economy in use,—in uniformity of action and equable motion.

6. The rotary engine is *peculiarly inapplicable to the great purposes* of terrestrial locomotion and steam navigation—objects to which it has been considered peculiarly suitable.

7. That the *present steam-engine is practically perfect* as a working machine, being within ten per cent. of mathematical perfection.

8. That the *crank* of the common steam-engine possesses certain *remarkable properties* of adaptation to the nature of matter, of motion, of steam, and the human mind; from which its supremacy as an elementary machine is derived,—properties which cannot possibly belong to any species of rotary engine.

Rotary engines may be arranged according to the mode of action into four classes.

Class I.—Rotary engines of simple emission.

Class II.—Rotary engines of medial effect.

Class III.—Rotary engines of hydrostatical re-action.

Class IV.—Rotary engines of the revolving piston. As closely connect-

ed with the rotary engines in the fallacy which has given rise to both of them, we may add a series of inventions forming,

Class V.—Revolving mechanism substituted for the crank.

Class I.—The rotary engine of simple emission forms the earliest, as well as the most rude and elementary method of giving motion to mechanism, by the escape of vapour or steam. It is described by Hero of Alexandria, in his *Pneumatika*, upwards of 120 years before Christ, and depends, for its effect, upon the same principle which gives to a rocket its career, and makes a fire-wheel revolve in giving off its beautiful lights. In these, as in all instances where fire, or steam, or any fluid or gas is generated in a chamber from which it is permitted to issue with violence, it will, in its exit, drive the vessel from which it issues away from it in the opposite direction, and is, in fact, merely an application of the principle of recoil,—where the gas, generated by the explosion of the powder, urges the ball outwards in one direction, and forces the breech of the gun backwards in the opposite one. The same recoil is felt in all cases of simple emission of a fluid from a reservoir; and if it be so arranged that water, steam, air, or the gaseous productions of gunpowder, shall rush out of a chamber through the arms of a revolving wheel, the openings of escape being properly directed, the recoil will urge round the wheel, and we shall have a revolving engine of simple emission. By availing himself of this principle, the mechanist of Alexandria produced an efficient engine, merely by heating a vessel containing water and air, and allowing the vapour to rush from the two opposite orifices at the end of two arms proceeding from a sphere which the emission was employed to move.

Instead of using the principle of recoil, the force of steam issuing with violence as we see it from the mouth of a kettle or boiler, may be directed upon the vanes of a wheel, so as to blow them round; and thus we have a second variety in the manner of converting the simple issue of steam into a moving power. This second species of the rotary steam-engine of a simple emission was invented by Branca, in 1629.

Since that time the engines of this class have been frequently re invented and slightly modified.

Inventors of Rotary Steam-Engines of the First Class.

1. Hero of Alexandria,	B. C.	130
2. Branca,	A. D.	1629
3. Kircher,	"	1643
4. Daslesme,	"	1699
5. Kempel,	"	1785
6. James Sadler,	"	1791
7. Richard Trevithic,	"	1813
8. Alexander Craig,	"	1834

The theory of machines of simple emission has been frequently and fully investigated, and the result is, that there is no possibility of obtaining, by simple emission, more than one-half of the whole power of the steam, so as to make it available to useful mechanical effect. The other half is wasted in giving off its impulsion to the air, or is expended in a current equally unavailing.

Practical experience corroborates the predictions of theory. Smeaton and Pelletan made the machines of simple issue the subject of careful experiment, and found that 3 parts out of 11, 8 parts out of 27, and 2 parts out of

5, are the highest measures of practical effect, that it has been found practicable to attain, and by no possible improvement can more than one-half of the whole power be turned to a useful effect.

Class II.—Rotary engines of medial effect are those which do not immediately give revolution to an axis by the action of steam upon the wheel, but have a *medium of communication* between the power and the effect, which medium is the direct agent in circular motion. This class of engines will be well understood by taking as its type any simple steam machine, such as Savary's and Newcomen's, used for raising water, which water by falling on the floats of a common mill wheel will then give rotary motion to it. The engine of Savary raises water by pressing directly on its surface, and it is only necessary to allow this water to fall on a wheel, when it will be made to revolve and form an engine of the 2nd class.

A variety of this class has been invented of which the fire-wheel of Amontons is a type. The stream pushes water through certain channels that form the arms of the wheel, from a set of chambers on one side of the wheel, to a corresponding set of chambers on the opposite; and thus the side filled with water preponderates over the other, and the wheel revolves The water being constantly driven off by the steam from a given side of the wheel to that opposite, uniform revolution is the result of the weight of the water. In this state, although steam is the agent, water is the medium of communicating the rotary motion.

Solids have also been made the medium of effecting rotation in this manner; weights of solid matter, in the form of pistons, have been transferred by the force of steam to a considerable distance from the centre on one side of a wheel; and drawn nearer to it on the other side, so as, by bringing about a continual preponderance on one side, to effect a revolution. Watt and Witty have designed rotative mechanism of this nature.

Inventors of Rotary Steam-Engines of the Second Class.

1.	Guillaume Amontons,	A. D. 1699
2.	Leopold of Plainitz,	" 1723
3.	Champion of Bristol,	" 1752
4.	James Watt,	" 1769
5.	Davidson & Hawkesley,	" 1793
6.	Richard Witty,	" 1810
7.	Sir W. Congreve,	" 1818
8.	John Moore,	" 1820
9.	Sir W. Congreve,	" 1821
10.	Thomas Masterman,	" 1822

In this class of engines the loss of effect is manifest, for it is necessary that the steam, in order to produce circular motion, shall give out its force in setting the medium in motion, and, in overcoming the very great resistance of the liquid in all the pipes, passages, and valves, through which it is transmitted to alternate sides of the wheel in every revolution; the whole of this force is subtracted from useful effect, and becomes power lost.

In those which move weights, from and towards, the circumference, there are mere groups of reciprocating pistons without cranks, and share the evils to be explained in Class V; in fact, in the engines of Watt and Witty of this class, we have *a series* of reciprocating engines ranged round a wheel to do the work of one.

In the case of the fluid medium, we have not only a loss of all the power expended in moving the medium itself, but also the additional loss of effect

encountered in all modes hitherto adopted for applying a fluid to the rotation of a wheel, a loss, in the best examples ever presented, amounting of itself to more than one-sixth part of the power.

Class III.—The engine of hydrostatical re-action is more effective than either of the former classes. As invented by Watt in 1769, it consisted of steam-vessels in the form of hollow rings, or circular channels, with proper inlets and outlets for the steam, mounted on horizontal axles, like the wheels and buckets of a water-mill, and wholly immersed in some fluid. This wheel was made of iron, six feet in diameter, and the re-action of mercury was employed to give revolution to it; the engine moved, but was found to be inefficient, and abandoned, although it has been tried in very favorable circumstances.

The principle of action is this: steam is admitted into a circular channel or chamber on the circumference of a wheel; this chamber is partially filled with some liquid, the pressure of the steam is expended in pushing the mercury in one direction, and the end of the chamber in the opposite way, so that while the liquid is thus forced out of the chamber, the chamber is by an equal force pushed away from the liquid; the wheel is thus turned round.

It is apparent that a part of the force is employed in propelling the wheel, and the remainder is expended in overcoming the resistance of the liquid of re-action, and expelling it from the chambers, which remainder is a large portion of the power withdrawn from useful effect.

Inventors of Rotary Steam-Engines of the Third Class.

James Watt, ...	A. D. 1782
Bryan Donkin, ...	" 1803

Class IV.—Rotary Engines, having a revolving piston, are constructed on a much better principle, and hold out much fairer prospects of a successful competition with those having the ordinary reciprocating piston, than any of the species of the three first classes that have been already considered. In these classes the steam is not confined in rigid vessels, but its action is applied to producing currents in fluids, and force is expended in medial effects which are useless, and therefore waste power. This is not the case with the steam-engine of the revolving piston. The steam is confined in a close and rigid chamber, and acts only on a solid inflexible surface, and makes its escape by confined passages, so that its full effect may be obtained in useful work. Abstractedly considered, it is an engine capable of giving out the full power of the steam, and therefore may fairly be imagined to come into competition with the ordinary reciprocating crank engine. The objections to it are entirely of a practical nature, and regard the engine not in its abstract mathematical form, but as a machine made of destructible matter, of matter imperfectly elastic, of surfaces opposing resistance to motion, of matter obeying the known laws of motion and rest. These objections are not the less valid that they are of a sensible and tangible, rather than a speculative description. But as a natural consequence of the more plausible deceptions held out by this species than by any of the three preceding ones, it has followed, that the fallacies of this class have been more widely seductive than any of the others. The Patent-office presents us with the names of more than forty victims, including some of the highest fame.

Inventors of Rotary Steam-Engines of the Fourth Class.

	A. D.		A. D.
1. James Watt,	1782	24. Robert Delap,	1821
2. James Cooke,	1787	25. Bambridge & Thayer,	1821
3. Bramah & Dickinson,	1790	26. William Foreman,	1824
4. Edmund Cartwright,	1797	27. Lord Cochrane,	1825
5. Jonathan Hornblower,	1805	28. L. M. Wright,	1826
6. William Murdoch,	1805	29. F. Halliday,	1825
7. Jonathan Hornblower,	1805	30. Joseph Eve,	1825
8. John Trotter,	1805	31. John Costigin,	1826
9. Andrew Flint,	1805	32. Marquis de Combis	1826
10. William Lester,	1806	33. Elijah Galloway,	1826
11. Richard Wilcox,	1806	34. Paul Steenstrup,	1827
12. Thomas Read,	1808	35. John Evans,	1828
13. Edward Jane,	1808	36. John Strut,	1830
14. Samuel Clegg,	1809	37. E. & J. Dakeigne,	1830
15. William Chapman,	1810	38. William Morgan,	1831
16. John Trotter,	1811	39. Samuel Hobday,	1831
17. William Onions,	1811	40. John Erricson,	1832
18. Richard Thevitic,	1813	41. Robert Stein,	1833
19. Joseph Turner,	1816	42. Elijah Galloway,	1834
20. John Mallam,	1818	43. Edward Appleby,	1835
21. Joshua Routledge,	1818	44. John F. Kingston,	1835
22. William Carter,	1818	45. John Yule,	1836
23. John Rider,	1820	46. John White,	1836

The fallacy of this class of engines we shall expose in conjunction with the next class, as the same misconceptions lie to a considerable extent at the door of both.

Class V.—Revolving mechanism substituted for the crank of the common steam-engine, for the purpose of obtaining from the reciprocating piston a rotary effect otherwise than by the crank, and in a better manner than by the crank, forms a class of inventions involving fallacies similar to those in which the revolving piston has originated. These two may therefore be considered together.

Inventors of Rotary Mechanism as a substitute for the crank.

	A. D.		A. D.
1. Jonathan Hulls,	1737	13. Edmund Cartwright,	1801
2. Keane Fitzgerald,	1757	14. Matthew Murray,	1802
3. Gautier of Nancy,	1757	15. Richard Witty,	1811
4. John Stewart,	1769	16. J. Dawes,	1816
5. Dugald Clarke,	1769	17. Tobias Mitchell,	1810
6. Matthew Washborough,	1779	18. Henry Penneck,	1827
7. James Watt,	1781	19. William Aldersey,	1821
8. Thomas Burgess,	1789	20. Robert Barlow,	1827
9. Matthew Murray,	1779	21. Thomas Peck,	1827
10. William Lander,	1799	22. Samuel Clegg,	1828
11. Phineas Crowther,	1800	23. William Lucy,	1836
12. George Medhurst,	1801	24. Charles Schafhautl,	1836

Although the name of Watt has been included in this list of inventors of substitutes for the crank, it should be observed, that he was only driven to the invention of such a substitute by the circumstance of a patent having been previously obtained for the crank in its simple form, and that he aban-

doned this beautiful, but more complex, mechanism on the instant that the elementary crank was released from the fetters of monopoly.

After combating with much demonstrative force the erroneous opinion of great loss of power by the crank, the author proceeds:

"In the reciprocating piston, therefore, acting through the crank, the whole power is found by multiplying the stroke and back-stroke, or twice the stroke of the piston, by the pressure upon it, and this is equivalent to the whole effect produced in the entire revolution of the crank; the pressure of the steam, and the space it moves through, are therefore the measure of the power.

In the revolving piston, the effect of the steam must be precisely the same, if the revolving piston be of the same size, and moves through the same space as the reciprocating piston; and if the revolving piston have a pressure on it equal to the mean pressure on the crank, and move through a circle equal to the circle of the crank, the effect will be the same in both cases.

Since there is no loss incurred by propagating the action of the steam on a reciprocating piston through the crank of a revolving axle, and since it is not in the power of machinery of any kind to augment the quantity of power given out by any mover, but merely to arrange, dispose, and modify that power to suit any given purpose, it follows that the rotary piston can have no purpose to accomplish, unless it excel the reciprocating one in simplicity and economy of construction, diminished bulk, durability, and economy in operation, facility of repair when deranged, diminished friction, or a peculiarity of adaptation to some individual purpose, such as steam navigation or inland transport.

I. As regards simplicity of parts, the engine with the rotary piston cannot excel the simplest forms of the reciprocating engine; take, for example, that form which merely consists of a cylinder, piston, and crank axle; where the cylinder, mounted on an axle, oscillates with the revolutions of the crank, which is immediately attached to the end of the piston rod, and which requires no moving valves of any kind, the steam being admitted and emitted through ports in the axle of the cylinder, which open and shut by the motion of the cylinder itself. Neither as regards facility and economy of construction does it possess superiority; for it will be readily granted to me, that whether the piston and channel in which it moves be rectangular or circular, they are more difficult of construction than a straight, round cylinder and piston, which being derived from the straight line and circle, are the simplest of forms, while an annular chamber, if the piston be rotary, is a surface of double curvature, of difficult construction and imperfect completion; if square, the construction of a rectangular piston is a still more troublesome attempt, the increased surface being increased expense and labor.

II. In point of bulk, the common reciprocating piston has a decided advantage; the annular cylinder of the revolving piston must be (to give equal power) about two-thirds of the area, and about three times the length of the reciprocating cylinder, being a bulk of cylinder nearly double. But even this is an estimate too favourable to the piston of rotation; the diameter of the axle requires to be very considerable; there are various reasons for this,—one is, that it is frequently a steam passage; another is that it is much larger than is required for the mere purpose of communicating the force; because any force of steam applied near the centre is of little value in pro-

ducing an effect, from the smallness of the circle which that part of the piston describes; and for this reason also, that the portion of piston exposed to leakage and wear is in proportion to the effect gained; the piston is therefore removed to a considerable distance from the centre, to answer the purpose, likewise, of rendering the revolution of the parts more nearly equal. These points will, however, have our attention at another time; it is sufficient for our present purpose, that these circumstances render it imperative to increase the bulk of the engine.

III. In point of durability and economy in its use, the most conclusive arguments lie against the rotary engine. I have seen many of them perfectly constructed, working beautifully, but they went very soon out of order. They invariably work best when new. This may appear to some to arise only from the defects incidental to particular modes of construction. I admit that many have had peculiar elements in their construction not indispensable to the principle. But, on the other hand, I shall now go on to show, that, independent of the idiosyncrasy of peculiar engines, the necessary mode of action involves elements of self-destruction very rapid in their operation, by means of which every rotary piston must soon wear itself out of condition.

It is a received principle in constructing machines, that, in a good engine, the parts should wear equally, and that even the very working of their parts should make them fit each other better. This is truly the case with the piston and cylinder, and other appendages of the reciprocating steam-engine. So true, that old engines of Messrs. Watt and Bolton—some of their earliest—are still working better than they ever did, or than some more recently made. To this the reciprocating engine necessarily presents a contrast: and it will not be difficult to show that its parts *must* wear unequally, so as to become unfit for use, and be rendered by each day's work less fit for the duty of the succeeding one.

To show the cause of this:—Suppose two perfectly flat plates of metal, perfectly round, to be laid one upon the other, so as exactly to coincide at every point. Let the undermost rest upon a table, and let the uppermost be made so as to turn round on an axis while in contact with the other, and let a rapid motion be communicated to the uppermost,—let me ask what will be the result of the attrition of the one of these upon the other? Will they wear equally, so as to remain in a state of mutual adaptation, or will they not? Experience furnishes an answer which exactly quadrates with reasonable expectation;—they will *not* wear equally,—they will *not* retain their forms. Let it be considered that the outer edge performs a larger circuit than any part nearer the centre; that, therefore, as all the parts revolve in the same time, those nearer the circumference move with a greater velocity than those towards the centre; that the attrition is more rapid at the circumference, and uniformly diminishes towards the centre of the plates; then it invariably follows that *the plates must become conical*, with a continual tendency to become more so. This is a most incontestible truth. It is one which has caused the failure of many beautiful inventions; it is the reason why conical bearings have been universally abandoned for cylindrical ones; and it is the cause that has rendered a most beautiful class of inventions totally useless to the improvement of the reciprocating engine. I allude to the flat *revolving valve* introduced by Oliver Evans, and afterwards brought into this country, but now universally abandoned, in spite of simplicity, efficiency, and economy, on account of this very attrition from a centre which we consider to be ruinous to every steam engine on a revolving principle.

The application of the result of this illustrative experiment to the subject in question, is abundantly obvious, the circumstance of rotation from a centre, with pressure on bearing surfaces of which the parts are at unequal distances from the centre, implies the excessive attrition of the circumferential surfaces above those which are near the centre, and which move with less velocity. Hence the circumferential surfaces wear more rapidly, and are unfit for use long before the central parts have suffered by any sensible effect. Where extensive metallic surfaces are in contact, their repair is a matter of much expense and delay.

To diminish this cause, or to delay its effect, the revolving piston is removed far from the centre of action. By this means, however, the bulk of the machine, and its friction, are very much increased, and the evil only partially remedied. It is obvious, however, that in this way, by increasing the radius, the engine is brought more nearly to the principle of the straight cylinder; so that perfection would just be attained if the circular cylinder were made straight, or, in other words, if the rotary engine were converted into an ordinary reciprocating engine.

When a piston reciprocates in a straight cylinder, all its points, and those of the cylinder, move equally, being in lines parallel to the axis; and to prevent accumulation of eccentricity, the piston may have its position on the circumference altered by part of a turn.

The essential nature of *rotary attrition* is therefore fatal to the success of the revolving principle,—a cause of expensive repairs, and speedy destruction.

IV. There are other defects to which this species of engine is peculiarly liable;—to vacuities and losses at the valves and passages—to irregular action, and collisions and shocks from the action of the parts one upon another; but these will be the subject of consideration as they occur in individual machines.

V. Unless, therefore, we shall find that there is some peculiar applicability in this form of engine above the common one, to certain important purposes, such as steam navigation and inland transport, we must abandon the hope of deriving practical advantage from the engine of rotation.

Now, it has been proposed for steam navigation, but to this it is peculiarly inapplicable. In a steam-vessel, it is useful to have the axis of rotation as *high*, and the weight of the engine as *low* as possible. Now, if the engine be placed on this axis, as it would be in the case of the rotary engine, one of two evils would follow; the axis would require to be much lowered, or the weight of the engine would be so high as to make the vessel the very reverse of steady. By such a disposition of its parts it must necessarily be rendered crank, and have its power greatly diminished. In the present engine, the weight is immediately above the floor of the vessel, and the axis in contact with the deck.

Applied directly to the axis of the steam-carriage or locomotive engine, there are insuperable objections to the rotary engine. As there would be no spring between it and the wheels, every jolt would derange the machinery. The weight of the engine, rigidly connected to the axle, would reciprocate the evil, and knock the wheels to pieces. These evils are prevented in the reciprocating engine, by the detachment of the engine from the axle, and the propagation of power through rods, wheels, or chains, to the propelling wheel or axis. It is indeed a radical defect in some of the existing forms of the locomotive engine, that the detachment is less perfect than might be desired. This very adjustment, so impracticable with the rotary engine,

was, even with the superior facilities presented by the form of reciprocating locomotion, one of the greatest impediments to the success of elemental locomotion.

VI. In addition to the above-mentioned advantages possessed by the reciprocating engine above the rotary one, it presents facilities (altogether wanting to the latter) for working directly the subordinate appendages of the steam-engine, such as cold water pump, its own feeding pump, &c. If the engine be a condenser, the simplicity of the reciprocating mechanism of the air-pump puts the rotary engine altogether *hors du combat.*

VII. All these considerations, of the most important practical bearing, demonstrate clearly to us, that if there be no very considerable loss of power in the reciprocating engine, we have little inducement to make the substitute of the rotary chamber and revolving piston for the cylinder and reciprocating piston.

It appears, on the contrary, both from theory and practical working of the steam-engine of ordinary construction, that, with a very small allowance for friction, the piston gives out through the crank, in actual work done, all the power of all the steam applied to it in the cylinder. Mechanism can do no more. And since neither simplicity of action, compactness of form, condensation of bulk, nor economy, either in the first cost or operation, gives it a superiority to the common engine, but that, on the other hand, from the very nature of its movement, it possesses the elements of rapid detrition and unequal deterioration, and is, by the necessary arrangement of its parts, rendered peculiarly inapplicable to such important objects as the purposes of steam navigation and land transport, I do not see what motive can possibly remain for devoting a single thought to its further improvement, or the alteration of its form, when its very principle holds out no higher premium than that, if brought to its utmost perfection, it might possibly approach in durability and efficiency the ordinary reciprocating engine, but in no point of view could ever excel it. To expend more time and mind on such a subject, is therefore merely sowing the wind to reap the whirlwind.

VIII. The force of the exposure I have now been induced to make of the fallacious nature of those attractions by which the rotary motion has drawn aside ingenious mechanists from the direct path of legitimate invention into the fruitless pursuit after ingenious trifles, will have considerable weight added to it, if we turn our attention to the *peculiarities of the crank*, as one of the elementary machines for the conversion of reciprocating into rotary action.

The crank, as the means of converting the reciprocation of the piston of a steam engine into a continuous rotary action, possesses singular and beautiful properties, which distinguish it from every other means of producing that conversion, and which appear to be so perfectly adapted to the nature of steam and the constitution of solid matter, that we are indebted to it materially, although indirectly, for the very great advantages we derive from the modern steam-engine as a source of mechanical power. Ingenuity has been taxed to the utmost to find substitutes for it, which should remedy the (imaginary) defects of the crank, but the mighty element has disdained them all, pounded them to powder, and thrown them from her. Like unskilful keepers, they have attempted to control a power by means which have only encountered the force they were designed to direct; and, after many vain efforts, it is found that the crank is the magic rod under which alone the mighty force of the element becomes peaceful and docile. Wheels, sectors, and racks, in various combinations have been made to as-

sume the functions of the crank, but they have uniformly been declared incapable. Once or twice it has happened that a substitute was obtained, but it was soon found that these (the sun and planet motion, for example,) were only cranks in disguise; and the useless mask was speedily dispensed with when the cause of its assumption had ceased to exist. It was an invidious patent alone that induced the immortal Watt to give the name of sun and planet to two wheels, placed one at the base and the other at the apex of the crank. The disguise appeared as the patent expired, and the simple unencumbered crank resumed its well-merited station.

The peculiarities of the crank which give it its unapproachable perfection as an elementary machine, I shall now go on to describe.

1st. I would observe, that in the reciprocating piston of a steam-engine the following things occur :—The piston is to be put in motion in one direction, then stopped; then put in motion in the opposite direction; stopped again; motion in the original direction once more begun and made to cease. At the commencement of the motion downward, a valve is to be opened for the entrance of the steam above the piston, which valve must be closed at the end of the stroke, and at the same instant in which one steam-valve closes, an opposite one must be opened to admit steam below the piston; at the same instant, also, a valve of eduction for the first portion of the steam must be opened, and a second valve of emission on the opposite side of the piston closed. At one and the same instant, therefore, the motion of the piston has to be stopped in one direction, and commenced in the opposite direction, one steam communication closed, a second opened, a third of eduction cut off, and a fourth renewed, and all this (for the perfection of the engine,) must be done with the most absolute precision.

But these processes, which produce the change of state from rest to motion, and from motion to rest, require time. Matter acquires momentum which must be gradually removed, otherwise that matter is subjected to concussion, as if by the stroke of the hammer, and either suffers or produces injury. And, on the other hand, when in motion, matter requires a force to stop it equal to the force that gives it that motion. These effects therefore, cannot be instantaneous;* and it is necessary that while the motion which the steam gives off be uniform and continuous, the parts of the engine itself shall be allowed time to be brought to a state of rest, without shock, concussion, or jolt, and as gradually and gently be again urged to their greatest velocity in the opposite direction. *All these with exquisite adjustment the crank effects;* it stops the piston as gently and softly as if it placed beneath it a cushion of eider down, and afterwards as gradually begins and accelerates its motion to its highest velocity in the opposite direction. The valves too, are opened with the same perfect adjustment, being performed with that gradual motion which proportions the largeness of the aperture to the supply of fluid required to be transmitted. An adjustment so complete could only take place by such a relation as subsists between the crank and piston, the one describing uniformly the circumference of a circle, while the other moves by simultaneous gradations of alternately increasing and diminishing extent. But this is not all that distinguishes the crank.

2d. It is one of the highest recommendations of a piece of mechanism, that any very slight error in its construction shall not very materially pre-

* "On sait que pression ne peut pas produire tout-à-coup une vitesse finie."—Larange, Mech. Analyt., p. ii. sec. x.

vent its usefulness; nor any slight derangement of its adjustment be attended with immediate destruction, but that on the other hand, the *efficiency of the mechanism shall be consistent with such degrees of correctness as ordinary workmen can accomplish, and with such care as ordinary attendants can be trusted to bestow;* also, that the process of disrepair shall be so gradual as to give timely warning of the necessary re-adjustment. Just such a piece of mechanism *is* the crank. It is at the top and bottom of the stroke, or in the line of the centres, as it is technically called, that the opening and shutting of the valves should take place; and it is just at this point that pressure on the piston can produce any effect on the crank; but suppose the valves not to open with absolute precision, suppose them to open and shut too soon or too late, then will the error at that part of the circuit be of comparatively small importance, because *just then*, the motion of the piston is so slight, that, through an arc of twenty degrees, it does not describe one hundredth part of a stroke, and the effect of any error in that space will not affect the crank by more than one hundredth part of its amount; any *error of adjustment is therefore diminished in effect to one hundredth part* of what would be produced, were the motion of the piston to be uniform in portions corresponding to the arc of description, as would be the case in any other species of rotary conversion.

3d. In like manner, errors arising out of construction, management, or wear, are diminished one hundred-fold by transmission through the crank. It has been to me a matter of frequent astonishment, that although I have seen at the mouths of coal-pits, small mines, and quarries, mere remnants of engines, frail rusty old fragments of iron and wood, working so loose as scarcely to remain upright upon their basements, they were still working within 30 per cent. of their full power.

4th. To all these circumstances, I may add, that the constitution of the crank is one reason why an engine may be constructed of enormous weight, and of the most unwieldy dimensions, without being thereby much injured in its working; because the crank acquires so slow a motion at the commencement and termination of the stroke, that it equally slowly communicates motion to all parts of the machine, and in a like manner receives from them the impetus which they give out in the act of being again slowly brought to rest towards the end of the stroke. The impetus, therefore, given to the reciprocating parts of the machine is *lent* not *lost*.

We have thus endeavoured to expose the nature of the fallacy under which they labour, who imagine that the present steam-engine, as derived from Watt, is a machine which "destroys" or "absorbs" a larger portion of the power it is designed to transmit, and who look to the rotary engines as a means of increasing the amount of the power given out in useful effect. That the rotary engines, which appear day after day, are not new, we show from the fact, that the five great classes which comprehend them all have been invented and re-invented by upwards of ninety individuals. That their inventions have been unsuccessful, is manifest, from the non-existence of their machines in the daily use of ordinary manufactures. That the failure of these contrivances did not arise from defects accidental to the peculiar arrangements and contrivances of the engines, is rendered probable by the great variety of forms in which they have been re-invented, tried, and abandoned. That they have not failed from deficiences in the workmanship and practical details, is rendered still more probable by the circumstance of finding among the names of inventors, those of the most eminent practical engineers. We have next shown that in theory, the crank

of the steam-engine in common use, cannot, as has been supposed, be attended with a loss of power, as such loss would oppose the established doctrines of virtual velocities; it is shown also from very simple and elementary considerations, that what appears to be lost in force, is resumed in velocity—that, in proportion as the mean force on the piston is greater than the mean force on the crank, in that proportion is the space described by the latter greater than the space described by the former. That the dynamical effect produced in a given time is exactly in the proportion of the steam expended in that given time; and thus we have arrived at the conclusion, that the common reciprocating crank steam-engine has not the faults attributed to it in theory, and which the rotary engines have been designed to remedy. We have next taken the practical view of the subject—in simplicity of parts the rotary piston has no advantage over the reciprocating piston; in difficulty of construction the rotary piston far exceeds the reciprocating engine—it is more expensive at the outset—it has more friction—it is more bulky, and less compact—it is inferior in precision and uniformity to the crank engine—and there is a radical fault inherent in the very nature of rotary mechanism, from which it follows that the rotary engine can never be rendered either an economical or a durable machine. We have further shown that, even if rotary engines could be made economical and durable, their very nature renders them unsuited to the great purpose of steam navigation and inland locomotion,—objects to which they have been considered peculiarly applicable. We deemed it an appropriate and instructive conclusion to our enquiry, to examine into the action of the crank, for the purpose of discovering what those remarkable qualities are which have given to the crank of the common steam-engine, its unrivalled superiority as an element for the production of circular motion, and a degree of perfection unattainable by any other mechanism. We have seen that well-constructed crank steam-engines are daily performing duty, which is within ten per cent. of the theoretical maximum of possible effect—of absolute perfection—that this practical perfection arises from the simplicity of the crank, from its wonderful adaptation to the nature and laws of matter and of circular motion in connexion with rectilineal motion—from its reduction of errors either in construction, adjustment, or management, so as to work well without the absolute necessity of greater intelligence, expertness, and precision, than belong to ordinary workmen; and from the compensating nature of the arrangements of its structure, by which it is accommodated, in a remarkable degree, to the necessary imperfections of all human mechanism.

It is my earnest desire, that this exposure may have the effect of inducing some of my ingenious countrymen to direct their exertions for the advancement of the arts and industry of Scotland, to other and more promising subjects of invention. A wide field is open to their exertions in the useful *applications* of the mechanical powers of the common steam-engine to the wants of growing civilization, and to the improvement of the condition of the human race. Let them direct their exertions to these objects, with the industry and unity of purpose which they have already displayed in the pursuit of the fascinating fallacy of a rotary steam-engine, and they will one day be reckoned in the glorious list of those who have been the benefactors of their kind, and the ornaments of Scotland.

Lond. Mech. Magazine.

Bichromate of Perchloride of Chromium.

This remarkable compound was discovered by Berzelieus; it was at first called perchloride of chromium, because when put into contact with water it was changed into chromic and hydrochloric acid. Its true composition was ascertained by M. Heinrich Rose.

M. P. Walter gives the following process for preparing this compound: put into a tubulated glass retort an intimate and finely powdered mixture of 100 parts of fused common salt, and 168 parts of neutral chromate of potash; an S tube is to be put into the tubulure of the retort, through which there are gradually poured 300 parts of concentrated sulphuric acid. The action is rapid from the commencement; intense red vapours, accompanied by much chlorine, are disengaged. The receiver is to be kept cold to condense the vapour. The acid must be gradually added, or otherwise a loss of the red vapours will take place, and besides this the contents of the retort rise and pass into the receiver. As soon as the acid is added, the retort is to be gently heated, and the heat is to be increased, until yellow vapours begin to arise; the operation is then finished. In the receiver there is found a liquid of an intense red colour, and a solid substance, which, according to M. Dumas is a compound of this substance with chlorine. By decantation they may be separated, and the liquor when rectified, so as not to obtain the whole of it, yields a compound, the boiling point of which is constant.

The liquid thus obtained is of a magnificent blood-red colour; it is volatile, and yields fumes abundantly; when put into a quantity of water it falls to the bottom in drops of an oily appearance, and is converted into chromic and hydrochloric acids. Its boiling point is 244° Fahr., and its specific gravity is 1.71; it acts rapidly on mercury; it is decomposed by sulphur, detonates with phosphorus, dissolves chlorine and iodine, and combines with ammonia with the disengagement of light. A small quantity mixed with concentrated alcohol combines with it with violent explosion, and the inflamed alcohol is projected with force. This unexpected action had nearly deprived M. Walter of his eyesight, and burnt him horribly.

The analysis of this substance by M. Walter, agrees with that of M. Rose, namely,

Oxygen, . . .	19.28
Chlorine, ...	45.14
Chromium, . . .	35.58——100.

Am. de Chemie, et de Physique, 66-391.

It appears to me that it would be more simple to consider this compound as an oxichloride of chromium, than a bichromate of perchloride of chromium. It might then be regarded as composed of

Two equivs. of Oxygen, . .	16	or 20
One equiv. of Chlorine, . . .	36	45
One equiv. of Chromium, . .	28	35
	80	100

Lond. and Edin. Philos. Mag.

On the action of Fermentation on a mixture of Oxygen and Hydrogen Gases; by M. Theod. De Saussure.

It is well known that the quantity of hydrogen gas contained in the atmosphere does not amount to 1-1000dth of its volume. Nevertheless th

decomposition of organic matters continually adds fresh quantities of this gas to atmospheric air; on the other hand there are few substances which occasion the combination of hydrogen with oxygen at common temperatures; and the circumstances which the combination requires, prove that the disappearance of the hydrogen cannot be accounted for in this way. M. de Saussure states that he has found that the combination is effected by the fermentation of organic substances universally distributed over the surface of the soil, even when on account of the smallness of their quantity and the slowness of their operation no rise of temperature takes place.

By exposing fermentable bodies in pieces of the size of a nut to the mixed gases, M. de Saussure has arrived at the following conclusions:—The combination of hydrogen and oxygen gases may be effected without inflammation at the temperature of the air, by bodies submitted to slow fermentation.

They usually produce this combination when they are accumulated and impregnated with a sufficient quantity of water to prevent their complete contact with the oxygen gas. If this contact be made by increasing the surface of the fermentable body, or by diminishing the quantity of water, the hydrogen gas is not absorbed, and the oxygen gas disappears in other combinations.

The porosity of the fermenting body greatly contributes to the destruction of the detonating mixture.

Many observations prove that the hydrogen gas which disappears by fermentation combines with the oxygen gas, in the proportion of the elements of water. The demonstration requires that the oxygen shall be employed only to form this water, and all the carbonic acid produced in the operation.

The fermentable substances mentioned in the memoir do not effect the combination of the oxygen and hydrogen gases before they ferment, nor when the fermentation is stopped by an antiseptic. Soils and humus, mixed with different earths, undergo a slow fermentation as soon as they are moistened, which gives them the power of destroying the mixture of oxygen and hydrogen gases.

Gaseous oxide of carbon, and carburetted hydrogen gas, obtained by decomposing water with red hot iron, were not destroyed by fermentation when they were substituted for common hydrogen gas, in the explosive mixture formed of two volumes of hydrogen gas and one volume of oxygen gas. Azotic, hydrogen and oxygen gases, added to the explosive mixture, do not present any remarkable obstacle to the destruction of an explosive mixture by a fermenting body, nor to that which is effected under the same circumstances by a plate of platina recently cleaned.

Oxide of carbon, and olefiant gas and others, which prevent the combination of oxygen and hydrogen by platina, are also great obstacles to the same result of fermentation.

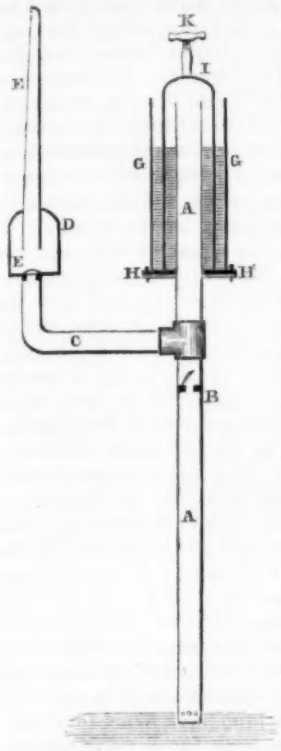
Nitrous oxide, added to the explosive mixture, was partly decomposed by fermentation, and did not prevent the combination of the hydrogen and oxygen gases.—*Bibl. Univ. Feb.* 1838.

Sup. to Lond. & Edin. Philos. Mg.

Mill's Mercurial Pump.

Sir,—Some time since I constructed a mercurial pump, on what I conceive to be a new plan. I presented a working model to Mr. Grier, lecturer on Natural Philosophy in the Baronial Hall, who exhibited it to his class,

and the action was so satisfactory to the lecturer and his audience, that I have been solicited to transmit you an account of the pump, which I hope you will not consider unworthy of notice in your excellent periodical.



The pump is of the suction kind; A, A, is a pipe not more than 30 feet in length, opened at both ends, the undermost of which is inserted in the well to be drained. At B, there is a clack valve opening upwards, immediately above which a branch pipe, C, leads off, and opens into an air vessel, D, of the ordinary construction. The top of the pipe, C, is furnished with a valve, E, opening upwards into the air vessel, and the ejection pipe is terminated at the required height, F. Immediately above the branch pipe, C, the main pipe, A, A, is begirt with a cylinder, G, G, of iron or glass. The cylinder is of greater diameter than the pipe, but screwed to it at the bottom, H, H, so as to be perfectly air-tight. The cylinder rises to the same height as the pipe, A, A, and the space between them is nearly filled with mercury. A cylinder open at the bottom, and of a diameter intermediate between the cylinder, G, G, and the pipe, A, A, is immersed in the mercury over the pipe, after the manner of a gas holder receiver, but so as to be capable of an easy motion upwards and downwards. The top of this cylinder is furnished with a handle, K. In consequence of the mercury in the cylinder, G, G, and of the valves, B and E, no external air can enter the main pipe, A, A, which enters the well; but the cylinder, I, being lifted by the handle, K, yet not so far as to come out of the mercury, the air within the pipe, A, A, will be rarified, and the pressure of the atmosphere will force the water from the well up the pipe, A, A, so as to pass the valve, B, which opens for its passage. When the cylinder, I, is brought down, the valve, B, shuts, the air is compressed, and the water having no other way of escape, passes through the tube, C, through the valve E, and into the air vessel, D, thence up the pipe and becomes discharged at the orifice, F.

The advantage of this pump is, that little friction is encountered, and for every inch of stroke of the handle, K, the water will be raised one foot.

JAMES MILLS.

Glasgow, 13, Clyde Terrace, March 30, 1838.

Lond. Mech. Magazine.

The foregoing is a somewhat novel application of a principle familiar to all who are accustomed to the raising and depressing of air jars in a hydro-pneumatic or mercurial cistern. G.

A New Water Power.

The discovery of a new application of water power, which is likely to be attended with the most important consequences, has lately been made

by a tradesman in Greenock. Like all truly valuable discoveries, it is distinguished alike for simplicity and efficiency. It consists of a cylinder and a piston similar to those employed in the steam-engine. To the cylinder there are two entrance and two discharge pipes, one of each on each side of the stuffing box of the piston. The same turn of the cock that admits the water into one part of the cylinder opens the discharge pipe in the other, and thus a vacuum is formed. To work this, advantage is taken of the pressure of the Shaw's Water Works, the height of the reservoir of which gives it a force of 60 lb. to the inch, in the lower parts of the town of Greenock. A short time ago, an experiment was tried with a cylinder 2 in. in diameter, worked with a jet of water of somewhat less than a quarter of an inch in diameter, and the piston, although loaded with 1¾ cwt., rose and fell 16 times in the minute. In this case the entrance and discharge pipes were equal in size, and the cylinder was placed in a vertical position. Since then, the discoverer has had another model with the cylinder laid horizontally, and with the discharge pipes nearly three times as large as the entrance ones, and by this means the motion was increased to 26 double strokes in the minute. The cheapness of an apparatus of this kind, and its efficiency, wherever there is a sufficient height of water to work it, must be obvious to all, while its manageableness and freedom from danger are no less conspicuous. The merit of this discovery is due to Mr. William Allison, a mason of Greenock, who first suggested this novel application of a well known power to Mr. James Baird, engineer, and Mr. A. Fairgrieve, plumber, who had materially aided him in reducing it to practice. One use to which Mr. Allison conceives it to be peculiarly applicable is, the hoisting of heavy goods into warehouses. The Shaw's Water Company, for 7*l.* a year, gives a supply of water equal to 1000 gallons per day. This water injected into a cylinder 10 in. in diameter, he calculates, will raise to the second floor 300 tons per day; to the third floor, 200 tons; to the fourth, 150; and to the fifth, 100 tons. The cost of the water for each day's work is about 5*d*. The goods in question will be raised at the rate of 39 ft. per minute. These calculations have proceeded upon the pressure of the water introduced into the town for domestic purposes; but a pipe from the Compensation Dam at the Paper Mill, from its superior height, would give a pressure of about 200 lb. on the inch.—*Greenock Advertiser* as quoted in the *Dumfries Courier*, Sept. 6, 1837.

Arch. Mag.

Whatever ingenuity there may be in the mechanical arrangements of the engine here described, there is nothing new in it with respect to the application of the principle on which it acts. G.

ARTICLES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

On the density of Clays, baked at various temperatures; BY AUG. LAURENT.

It is well known that certain clays have the property of diminishing in volume when heated, and that this diminution increases with the temperature; whence it might be inferred that the density increases in the same

proportion. This conclusion, however, is not accurate, and though the contrary may appear absurd, the absurdity is only apparent, as I am about to demonstrate.

Having cast a prism of kaolin diluted with water to render it more homogeneous, and dried it at about 150°.

Its length was, -	0m.236
Its weight, - -	10gr.852
Its density, (in powder,)	2.643

I exposed the prism, during 6 hours, to a red heat, capable of melting an alloy of three parts silver and seven of gold.

Its length was, -	0m.233
Its weight, - -	9gr.852
Its density, (in powder,)	2.643

Thus far nothing remarkable appears. The volume diminished and the density increased, but not in the same proportion, for there was a change of chemical constitution, since the hydrosilicate of alumine lost about eight and a half per cent of water.

The prism was then heated about six hours at a temperature capable of melting an alloy of equal parts of gold and platina, (temperature of assays of iron.)

Its length became,	0m.212
Its weight,	9gr.814
Its density, (in powder,)	2.481

If its length and weight be reduced to a centesimal scale, we have

	at 150°	at a red heat.	at a white heat.
Length,	100	98.72	90.98
Weight,	100	89.62	89.66

From the red to the white red heat the weight remained sensibly the same while we see that the volume was considerably diminished. It was the same with the density which from 2.643 changed to 2.481.

Having taken another piece of kaolin, I heated it successively, at various temperatures, taking the density each time, and obtained the following results:

	Density.
At 100°	2.47
At 150°	2.55
At 300°	2.60
At a dark red	2.70
At a bright red	2.64
At a temperature somewhat inferior to an iron assay,	2.50
At the iron assay temperature,	2.48

The volume diminishing continually from beginning to end, we perceive that the density increases by degrees to a dull red, at which it is a maximum; that the weight diminishes equally as far as this temperature; and that from this point the density diminishes as well as the volume, while the weight remains constant.

It is very easy to account for the diminution of the density beyond the dull red, considering that the volume, measured in mass, is only an apparent volume, composed of the real volume of the particles and the volume of the air which separated them from each other. By the heat, the parti-

cles approached each other, the intervening air being expelled, and they increased in volume, at the same time. It is similar to what would be observed if we were to take a cubic litre of the filings of beaten gold, melt it and find that it occupied but half a litre, and then ascertaining that the density of this melted gold, reduced to powder, is less than that of beaten gold. As to the cause of the increase of volume of the particles of clay, we may attribute it to the combination which gradually takes place between the molecules of silica and alumina, which are only mixed or partially combined in the unbaked clay. This is conformable to experience which teaches us, that almost always, when two bodies combine, the compound has a density less than the mean density of the two component materials.

Ann. de Chim. et de Phys.

Action of Iron on Benzoic Acid at an elevated temperature; BY FELIX D'ARCET.

In passing the vapour of Benzoic acid over iron at a red heat, we obtain a yellowish oil, fluid, and having an impregnated odour mixed with that of bitter almonds.

This impure oil, distilled in a sand bath, leaves a residuum of tar, and a very fluid colourless liquid distils over, of a peculiar odour.

This liquid boils at 86°, C. At —6° it congeals.

A quantity weighing .235 gr. treated with the oxide of copper, gave .168 gr. of water and .794 gr. of carbonic acid.

Its composition therefore is,

Carbon,	92.065
Hydrogen,	7.935
	100.000

which gives the formula $C.^{24}$ $H.^{12}$

		Calculated.	Found.
C^{6}	229.5	92.4	92.06
H^{3}	18.7	7.6	7.94
	248.2	100.0	100.00

This material is therefore Benzine, and its formation is explained in the following manner.

C^{28} H^{12} 0^{4} Benzoic acid,
C^{24} H^{12} Benzine produced,

C^{4} 0^{4} Carbonic acid.

When the temperature is raised, carbonic oxide is obtained; but if the temperature is lowered, to a dull red, for example, carbonic acid only is collected.

Benzine may also be obtained, by distilling a mixture of benzoate of potash and arsenious acid. I have had this reaction in seeking a body analogous to the liquor of *Cadet*.

Ibid.

Action of Iron upon Camphor at an elevated temperature.

BY M. F. D'ARCET.

In directing the vapour of camphor over iron at a red heat, an oleagi-

nous liquid gathers in the receiver which is very fluid and of a yellow colour.

In distilling this first product in the sand bath, nothing is obtained, and it becomes necessary to raise the temperature to about 145°, then a vapour passes off, and a liquid, slightly yellow, is formed, lighter than water, of a peculiar aromatic odour, having no resemblance to that of camphor, if the operation be slowly conducted.

.187 gr. of this material gave .129 gr. of water and .622 gr. of carbonic acid, by burning it with oxide of copper,—whence its composition is

Carbon,	92.35
Hydrogen,	7.65
	100.00

and its formula; C^{24}. H^{18}.

		Calculated.	Found.
C^{24}.	918.0	92.43	92.35
H^{18}.	74.8	7.57	7 65
	992.8	100.00	100.00

This substance boils at 140°; its composition is exactly the same as that of benzine, but its properties are very different. Can it be a new case of Isomerism? Time does not allow me, at present, to study it with the requisite care: on my return, I shall resume the task and endeavour to clear up this reaction. I have, besides, observed, that when the operation is performed at an elevated temperature, independently of the liquid above obtained, napthaline is also formed. Ibid.

Preparation of metallic Candle Wick.

Melt 100 parts of tallow, or wax, or any mixture of these, and add 5 to 10 parts of carbonate of lead well pulverised. The materials easily unite by stirring. Steep the wicks in this composition while warm and fluid. When cold the candles may be made upon them by dipping or moulding. In burning these candles the carbonate of lead is decomposed by the heat, and little globules of lead collect on the top of the wick, which bend it out of the flame and thereby increase the beauty and brightness of the light.

Jour. de Conn. Usuelles.

Improvements in Areometers and Thermometers; By M. Dinocourt.

The scales of the French Areometers or Pese-liqueurs are traced on a strip of paper which is introduced into the glass tubes which form the stem of the instruments, and is attached to it by a little sealing wax. These paper scales are liable to become displaced, especially when the instrument is dipped into warm, or hot, water, and thus its value becomes completely vitiated by giving false indications.

This inconvenience has been sometimes avoided by marking the degrees of the scale with a diamond, or by fluoric acid, but this method has been given up in consequence of the difficulty of reading the divisions when thus made, and more especially from the weakening of the glass which they occasion.

M. Dinocourt, agreeably to a report made by Francoeur to the *Societé d'Encouragement* has much improved these instruments by giving the marks

an invariable position on the stem, and at the same time preserving their easy legibility. These he effects by using an enamel powder mixed with gum, tracing the divisions and figures with a pencil, and then by exposing the glass to the flame of an alcoholic lamp so as to bring it to a red heat, the enamel becomes fixed to the glass. Great address is required in this operation so as not to injure the accuracy of the instruments, but Dinocourt executes this delicate work with perfect success.

As strong acids would corrode the enamel, the artist, in the construction of his pése-acides, marks his divisions with gold, which is proof against all but the nitro-muriatic. Various methods have been tried to attach the paper scales immovably to the stem by narrowing the neck, by a spiral wire, by rims of glass soldered to the stem, but none of these expedients have been satisfactory. M. Dinocourt, says the reporter, appears completely to have solved the problem. It is true that his Areometers cost more than the common ones, (his price being from 2 to 3 francs,) but the difference is more than compensated by their superiority.

Thermometers to be used for taking the temperature of acid fluids require similar precautions. M. Dinocourt has applied his improvements to these instruments with the same success. His thermometers cost but five francs.

Bull. d'Encour't.

New method of analysing the Ores of Manganese; By M. Ebelmen.

The process I would recommend appears to me susceptible of great exactness, and it has the advantage of being very easy of execution. It consists in receiving the chlorine, disengaged by muriatic acid from the ore, in a solution of sulphurous acid thoroughly freed from sulphuric acid, and saturating the sulphuric acid produced by muriate of Barytes.

Put a gramme of the ore to be tried, reduced to a coarse powder, in a small vial to which is adapted a bent tube, and pour on it a convenient quantity of muriatic acid. Let the chlorine disengaged pass into a flat bottomed receiver of about 8 oz. about two-thirds full of a solution of sulphurous acid. The chlorine may be disengaged very rapidly as the absorption is always complete as long as sulphurous acid remains in the solution which may be determined by bringing the nose to the edge of the receiver. When the muriatic acid begins to lose its brown tint, the ebullition must be rapidly urged to prevent absorption and to expel completely the disengaged chlorine. Then add muriate of barytes to the sulphurous acid solution, and boil it to drive off all excess of sulphurous acid. Clear the deposite by filtration, and the sulphate of barytes thus obtained gives the proportion of oxygen sought. An atom of sulphate of barytes $\ddot{S}Ba = 1458.09$ corresponds to 100 of oxygen. The chlorine in acting on the sulphurous acid solution, reproduces the oxygen which was disengaged from the ore in passing to the state of protoxide: now 100 parts of this oxygen enter into the composition of 1458.09 parts of sulphate of barytes, and I have elsewhere proved that hyposulphuric acid is never formed by this re-action whatever might be the excess of sulphurous acid, for in evaporating the liquor freed from sulphate of barytes to dryness in muriatic acid, and taking it up with water, no traces of sulphate of barytes remained.

The advantages of this process appear to me to be—1st. We are certain that the process at every instant is going on well, that the whole of the chlorine is absorbed and that nothing is lost at the stopper. 2d. That the ore is completely attacked and in a very short time. 3d. This mode presents

an advantage over that of digesting the manganese in sulphurous acid itself, which is a slow process, and which moreover takes from the oxygen of the manganese that which converts the oxide of iron to a protoxide, and therefore does not give the true value of the ore in relation to the chlorine it may produce. Finally, by the last named method, a great quantity of hyposulphate of manganese is formed, the decomposition of which is long and difficult.

Instead of employing sulphurous acid of recent preparation, we may use solutions of long standing and which contain, of course, sulphuric acid. It is sufficient to add to these a certain quantity of muriate of barytes; as oxygen is absorbed, sulphate of barytes is precipitated. When used, decant the clear fluid. The chlorine is then passed into a mixed solution of sulphurous acid and chloride of barium; each bubble of chlorine gives rise to a portion of sulphate of barytes.

Annales des Mines.

Crayons for Drawing on Glass.

Take equal quantities of asphaltum and yellow wax and melt them together. Add lampblack sufficient to give the mixture the requisite colour, stir it well, and pour it in moulds for crayons.

The glass should be well wiped with leather, and in drawing care must be taken not to soil the glass with the fingers.

It is sometimes difficult to trim the crayons with a common knife, for if too sharp it cuts in too much, and if too dull it cannot make a fine point. But if the edge be bevelled like scissors, and very sharp, the point may easily be rendered very fine.

Rec. de la Soc. Polytec.

Observations of Berzelius, on the methods of Paton *and* Marsh *for detecting Arsenic.*

To discover arsenious acid in animal matter, Paton recommends, 1st, to precipitate all these materials from the solution by an infusion of nut galls, and then to decompose the arsenious acid by sulphuretted hydrogen. It is not certain that this method is preferable to that of Taufflieb in which the animal matter is precipitated by a solution of oxide of zinc in caustic potash.

Marsh proposes another method which is worthy of all attention, as it succeeds with extremely small quantities of arsenic.* It is based on the transformation of arsenic into arseniuretted hydrogen, which, according to his statements, takes place very promptly when the suspected mass is acidulated with sulphuric acid, and a piece of zinc added. The hydrogen gas disengaged takes up the arsenic, and Marsh has contrived a very ingenius little apparatus for the experiment, but he manages the gas badly for the purpose in view. He passes it through a fine opening, inflames it, and then receives the flame either on a glass plate, or in a glass tube open at both ends, on which the arsenic is deposited in a metallic state or mixed with arsenious acid.

Marsh has neglected one property of this gas of which we may avail ourselves with much greater certainty, viz. that of depositing its arsenic by heat. Nothing more is necessary than to direct it into a tube heated to redness in one spot; the arsenical hydrogen is decomposed, the arsenic depos-

* See Jour. Frank. Inst. Vol. XVIII, page 338.

ited in the adjacent colder portion of the tube, and the hydrogen gas escapes in a state of purity. For this purpose nothing more is necessary than a common gas bottle, leading the gas, as it issues, through a glass tube, made hot by a spirit lamp. We may, if inclined to greater certainty, put into the red hot part of the tube, a small weighed quantity of copper reduced by hydrogen, white arseniuret of copper is formed, and by re-weighing it, we may estimate with the greatest exactness the weight of arsenic which accompanied the hydrogen.

I dissolved a millegramme of white arsenic in a little dilute sulphuric acid, and added above 6 ounces of water and some zinc. The hydrogen was passed over a little weighed copper, previously reduced by hydrogen and heated to redness in a narrow glass tube. The presence of the arsenic was very evident; the anterior portion of the copper became silvery white, and heated by the blow pipe it diffused a strong odour of arsenic. Having made the experiment with a centigramme of arsenious acid, I obtained about two-thirds of the arsenic which it contained, combined with the copper. This process, admitting it not to answer for a quantitative, deserves our entire confidence in a qualitative analysis and in its application to every case of medical jurisprudence. Jour. de Pharmacie.

To dye Wool and Goat's Hair a delicate blue.

M. Buisson, apothecary, has communicated to the Royal Society of Agriculture at Lyons a new and very simple process. The colour is strong enough to resist water, the sun, and even soap, while that obtained by dye woods fades much more easily, and is very inferior in brightness in an artificial light.

To obtain this colour as pure, fresh and deep as possible, the water of the bath while cold must be first saturated with chrystallized verdigrease (acetate of copper.) then slightly acidulated with acetic or pyroligneous acid; dip the stuffs in the usual way, then wash and dry them.

Jour. de Conn. Usuelles.

Composition of a Varnish for common Candles intended as a substitute for wax candles.

Take equal parts of the balm of benzoin and resin mastic: put each of them in a separate vessel of glass or lead, add spirits of wine, and heat them gently till the resinous parts are dissolved. Let each of the solutions remain a while at rest and then unite them in one vessel.

Prior to using this composition it is advisable that the fluid be heated to 25° or 30° Cent. (= 80 or 90 Fah.) Dip the candle in it from 5 to 10 seconds, then dry it carefully, which will take about 10 minutes. The proportion of the ingredients may vary, but in proportion as the benzoin is diminished and the mastic increased, the candles becomes more liable to soften by handling. If the benzoin be increased, the candle dries too soon and loses its polish and colour. The quantity of alcohol will vary according to the thickness of the coat to be given to the candle. Ibid.

Protest.

M. Pistrucci, who holds a station in the mint at London, is announced as the inventor of a process for striking a matrix with a punch which has never

een touched by the graver, and which gives, nevertheless, a medal identially the same as the original model in wax. In this operation, the beauty nd perfection of the design are at a single blow transferred to the metal whether of gold, silver or copper.

"The process is this: The model being given in wax, earth, wood, or ny other convenient material, take a mould of it in plaster, when the mould s dry or oiled: to harden it, take an impression of it in the moulding sand or cast iron, as fine as possible in order that the points may be sharp, and hat the materials may become as hard as tempered steel. The back is to e dressed to a plain surface. This piece solidly fixed in a piece of steel, ecomes the matrix on which may be struck, either the medal itself, or a unch if it be desired to multiply steel matrices of the medal. M. Pistrucci has tried his process on medals three inches in diameter and with perfect success. The importance of such a discovery is very obvious. Not only medals, but many pieces of jewelery which require to be chased, may be treated in the same manner."

Permit me to say, Mr. Editor, that this important discovery, as you may be easily convinced, is two years and a half old. At that epoch I made known at the Royal Mint in Paris, all that M. Pistrucci has just done in London. A plan of the apparatus and the details of the operation were deposited by me in the Royal Mint, to be placed at the disposal of my fellow labourers in France. They are in the cabinet of the director of the mint.

Since that time the medal engravers have employed my process, and more than thirty medals of the reign of Napoleon have been thus re-produced. You may easily, Mr. Editor, obtain a proof of my statement on application at the Mint.

Caqué, Engraver in the Gallery of the Kings of France,
Royal Mint, Paris.

Jour. de Conn. Us. et Prat.

Method of cleaning Glass.

Reduce to very fine powder a piece of indigo, moisten a rag, apply it to the powder and smear the glass with it. Wipe it well with a dry cloth.

Very finely sifted ashes applied in the same manner by a rag dipt in brandy or spirits of wine will answer well; but spanish white ought to be rejected as it is apt to take off the polish of the glass. Ibid.

Progress of Physical Science.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

On the part which the Soil acts in the process of Vegetation. Memoir read at the Academy of Sciences, by J. PELLETIER.

The ground is the support and nurse of plants; in its bosom, by means of roots, they seek for and find a portion of their nourishment. But to this truth, so simple and obvious, are attached questions of a complicated nature, and of the highest interest to Physiology and Agriculture. With one, among others, I have been particularly arrested, and it has been the object of my meditations. Before I enter upon it, permit me to bring into view some facts which appear to be necessary to the discussion of it.

The earth is not an elementary substance. Its exterior bed, the residence of plants, is formed of various metallic oxides, silica, alumina, lime, to which are often joined magnesia and the oxide of iron. It contains, moreover, the detritus of organic matters which had before possessed life and existence. Thus constituted, and under the influence of air, water and imponderable fluids, the earth is eminently fit for the development of germs deposited in its bosom, and to the growth of the vegetables which flourish upon it.

The necessity of the presence of organic matter, to constitute a soil, endowed in the highest degree with vegetative force, cannot be considered doubtful. In vain did Tull, in 1773, attempt to maintain that distinct earthy particles formed the sole nourishment of the plant. This theory was overturned by the positive experiments of Duhamel, who had at first embraced it. Nevertheless, if it is certain that the presence of organic matter is a condition of fertility, we may still ask whether it is so *essential* a condition—such a *sine qua non*—that a plant cannot vegetate in a soil totally deprived of organic matter, particularly if other circumstances, such as the presence of water and carbonic acid, be united with it.

Numerous experiments have been made to resolve this question. Many of them are contradictory. The greater portion, from the high interest which they involve, ought to be discussed and repeated with care. But another question not less important, and which I think ought to be first ascertained, is this: *What influence have soils themselves in the act of vegetation?* To this question I at present confine myself.

A vegetable soil, in its normal state, must be considered a mixture of various earths, that is, of metallic oxides.

Every soil devoted to Agriculture, is, in general, says Chaptal, formed of a mixture of silica, lime and alumina, and in support of this assertion he cites various analyses.*

Davy confirms this statement in his Agricultural Chemistry, and in fact,

* A very fertile soil in Sweden was found by Bergman to consist of:

Coarse Silex,	30 } 56
Silica,	26 }
Alumina,	14
Carbonate of Lime,	30
	100

A fertile soil in Middlesex gave Davy—Siliceous Sand 3-5; the remaining 2-5 consisted of

Carbonate of Lime,	28
Silica,	32
Alumina,	39

Analysis of a fertile soil in Touraine:

Sand,	49
Silica,	16
Alumina,	10
Carbonate of Lime,	25
	100

A very fertile compost, formed by Tillet consisted of clay 3-8, pulverised lime-stone 3-8, sand 2-8, corresponding to

Coarse Silex,	25
Silica,	21
Alumina,	16.50
Carbonate of Lime,	37.50
	100

not a single instance of a fertile soil has occurred, which consisted of only one earth, or even of two, such as lime and silex, silex and alumina, allumina and lime.

In another passage in his *Chimie Agricole*, Chaptal expresses himself thus: "A mixture of lime, silex and alumina forms the basis of a good soil; but that it may possess all the desirable qualities of good land these ingredients must exist in certain proportions, which analyses of the best soil can only establish.

If we consult the analyses of the most fertile soils, we find that fertility diminishes in proportion to the predominance of either of these principal earths, and that it becomes almost null when the mixture has the properties of only one of them."

Complexity of composition is therefore, in general, a condition of fertility in a vegetable soil. The loose earth which we find in vallies arising from the decomposition of primitive rocks, makes generally an excellent soil. Now, we know that granite, composed of quartz, feldspar and mica, and frequently amphibole, must yield by its decomposition, a soil containing silica, lime, alumina, and a little magnesia and sometimes potash. Soils, originating on the contrary, from the decomposition of more simple rocks, siliceous limestone, for example, are lighter, and suitable only for a limited number of plants; they require, says Chaptal, to be enriched, and are valuable only in moist climates. Land originating in the decomposition of trap, basalt and other rocks of complicated elements, possesses, on the contrary, great natural fertility.

"Rivers," he further adds, "receive in their courses other streams whose mud is mingled with its own, and it often happens that the united sediment of two rivers possesses greater fertility than that of either separately."

This then appears to be an established fact, that a soil, (independently of organic matter) is the more fertile as its composition is more heterogeneous.

If we seek for an explanation of this fact, we find in authors only vague opinions and doubts; the greater number merely state the facts without attempting an explanation.

Agricultural chemists, who indulge more in theory, appear to regard the cause of fertility as dependent on the physical character of the soil rather than on its chemical constitution. Thus Davy having observed that different soils attract moisture with different degrees of energy, and having discovered, as he believed, that the most hygrometric soils were the most fertile, he ascribes their superior fertility chiefly to this property. But Davy has not proved that the hygrometric force of a soil bears any given relation to its composition.

If this attraction for moisture were the principal cause of fertility (abating the influence of manures) we perceive no necessity for the combination of the three earths in the constitution of a soil of the first quality. Indeed a certain quantity of alumina in a soil otherwise entirely siliceous, or entirely calcareous, a certain proportion between the adhesive and the loose or sandy portions, would be sufficient to confer this hygroscopic quality, and of course the fertility of the soil. But we have nothing to confirm this supposition.

The hygroscopic quality of a ternary soil may then be considered as an *element* of fertility, but only a secondary element, subordinate to its chemical composition.

The property of becoming more or less heated by the rays of the sun, which appeared to Davy to hold a relation to the fertility of different soils, appears to me to be also a secondary cause. In the cases referred to by him there was a mixture of black mould, and he did not sufficiently consider its fertilizing action as a manure upon the soil.

To me, it appears evident that the mixture of the various earths which compose a soil, acts upon vegetation and determines its fertility *by an electro-chemical force*, whose action has been clearly recognised in other circumstances, but not yet brought into view in the case now under consideration. In the first place, let us observe that it is a fact, though the truth may have escaped observers, or rather, it has not yet been brought under a formula, that the silica, alumina and lime which enter into a good vegetable soil, must not be combined with each other, but simply mixed, the lime being in the state of a carbonate. A triple silicate of lime or alumina, in which the silex, lime and alumina should be in the proportions which constitute the best arable land, could not, even if thoroughly divided, furnish a soil essentially adapted to vegetation. If in a fertile soil, composed of a mixture of lime, alumina and silica, a combination between these three oxides should begin to take place, the ground would become cold and sterile. Now, it is certain that in a mixture of these three ingredients, a force does exist which tends to combine them. The silica and alumina are, in relation to the lime, electro-negative bodies, and in their presence the lime must acquire a contrary electricity. According as external or mechanical movements of the soil, or other foreign causes, shall bring these molecules within greater or less distances from each other, and group them in various ways, electrical piles will be established, discharges will take place, producing various tensions, and the earth will thus, if we may use the term, become animated. The electric fluid which pervades it will excite the stomata of the radical fibrils, determine the play of the organs, and the absorption of the fluids requisite to the nourishment of the plant. The radical fibrils, and the capillary roots impregnated with moisture, will become so many electrical conductors, engaged in transmitting electricity, certainly as necessary to life as light and caloric.

The merit of a theory is that it accounts for observed facts, enables us to foresee what will take place under particular circumstances likely to happen, and indicates the considerations which it may be desirable to bring about with a view to useful results.

Let us enquire whether the theory now presented fulfils these conditions: Suppose a chalky soil. To improve it we add argillaceous marl; i. e. to the lime which predominates we add silica and alumina. *To the positive element which we found alone, we add the negative elements which we found deficient.*

Will it here be said that "chalk is so compact that the roots cannot penetrate it, or so split up that water passes through it like a riddle, and that the marling is simply designed to change this physical condition."*

But, if the object was merely to divide the chalk, in order to change its physical condition, a calcareous sand would accomplish this object, and yet it never came into the head of an agriculturist to improve his chalk by limestone, while Gordan de Saint-Memin produced a magnificent vegetation by a mixture of chalk with heath sand.

In a piece of ground belonging to Chaptal, the soil was clayey and rather barren; below was a layer of black earth. Chaptal went to work empirically, dug up the ground and mixed the two beds together. Contrary to his expectations, the sterility was increased. It was not till the fifth year that the ground acquired a common degree of fertility, that is, when all the iron had passed to the state of peroxide, and the land, black as it was, had

* G. Dict. d'Agriculture, article *Craie*.

become of a deep, bright yellow. Chaptal asks, if in this case the black oxide is injurious to vegetation, either by itself, or in reference to the oxygen.

In our theory the fact explains itself, and might have been foreseen:—the black oxides of iron (fer oxidule' d' Haüy) is a combination of protoxide and sesquioxide of iron, a substance *indifferent* in relation to silica and alumina. Exposed to the air the combination is destroyed, the iron passes to the state of peroxide, susceptible of union with silica and alumina. Yet, under such circumstances it was not worth while to mingle the two beds, since five years were lost in attaining a common degree of fertility.

The theory which we have adopted is applicable likewise, in the happiest manner, to the operation called marling. Marl is not a simple mixture of silica and alumina with more or less of carbonate of lime. Its base is argillaceous and calcareous silicates; some mineralogists consider it even as an oryctognosaical species.* It is on this account that plants cannot vegetate in marl which has not been long exposed to the air, even when the silica, alumina and lime are in the proportions which form good arable land. By exposure to the air, carbonic acid *destroys the combination* which existed between the earths, and it is then, and then only that marl will enrich the soil. In this case, if the negative element prevails, as in the case of argillaceous marls, it becomes excellent for calcareous soils; and marls called calcareous are in their turn advantageous for argillo-sandy land.

It has been remarked that the alkaline and earthy salts, which, in a certain quantity, injure vegetation, produce a good effect when employed in small doses. Chemists and farmers have sought to explain this action of saline compounds. Some have thought that certain salts were good for plants, as some are for animals,—that salts, and even earths, formed part of the food of vegetables; others, on the contrary, that they act principally as stimulants to vegetation. Without denying that earthy substances may enter into the constitution of a vegetable, to unite and give strength to the parts that are to support the organs, like phosphate of lime in the bones of quadrupeds, I may remark, that with a few exceptions, the presence of any salt is not absolutely necessary to vegetation. Thus, for example, borage and lettuce, whose extracts contain much nitre when they grow in highly manured soils, do not contain any sensible portion of it when cultivated without dung. I therefore, rather incline to the opinion of Physiologists, who think with M. Decandolle, that salts act as excitants or stimulants. But, what is the meaning of excitation? At the present day, science no longer admits of those vague explanations which consist of nothing but words. I understand by excitation, the eminent property of conducting electricity which salts communicate to water. It is in this manner, as it appears to me, that nitrate of potash acts, in the prodigious energy which it gives to vegetation. It is probably in this way that sulphate of lime acts—that is to say, by rendering the water a better conductor, though in this case the effects appear to me to be complicated, and to be worthy of direct experiment.

Thus far, for greater simplicity, we have considered lime as free, in speaking of the mixture of silica, alumina, and lime, which constitute a soil: now the lime is in the state of carbonate, but it does not in that state cease to be an electro-positive element in relation to silica and alumina. This circumstance allows us to explain an important vegeto-physiological fact.

* Brochant's Mineralogy.

The carbon in vegetables is produced mostly, if not entirely, by the decomposition of the carbonic acid which they absorb not only from the air, but from the ground: such is the opinion of the celebrated Decandolle. This carbonic acid, furnished by the ground, appears to enter into the vegetable at the moment of its liberation, probably dissolved in the water which the soil contains. It is absorbed by the spongioles of the radicules; it ascends with the sap, urged forward as by a *vis á tergo*. But how is this carbonic acid produced? In certain manured soils, and in superficial portions of the earth, penetrated by the air, we may conceive it to be formed by the re-action of oxygen upon the carbon of organic detritus; but at those great depths which are attained by the roots of oaks and cedars of a hundred years old, how can the carbonic acid be developed? How can the oxygen and organic matter penetrate to such depths? In our theory there is no difficulty. Carbonic acid comes from the lime, on which the silica and alumina act slowly but continuously to form silicates.*

Thus then, at certain depths, and under influences but little understood, silica would decompose carbonate of lime, while at the surface of the earth, and under the influence of exterior agents, the silicates would be decomposed by carbonic acid produced by the re-action of the oxygen of the air on organic detritus,—an admirable and providential rotation, which re-establishes the equilibrium, and incessantly tends to the rejuvenescence of nature.

The last corollary of my theory,—the decomposition of silicates by exterior agents, and particularly by carbonic acid, cannot be called in question. It has been established by M. Becquerel, under circumstances in which the force of cohesion might seem to present a serious obstacle. I allude to the decomposition of the feldspar of granite, and the formation of kaolin. The analogy is here so strong that I must render the homage of my first conception to the distinguished academician I have just cited.

The fact of the decomposition of carbonate of lime by silica in the interior of the earth is equally supported by experiment and observation. And first, if, in proceeding to the analysis of a vegetable soil, when the coarser siliceous sand has been separated by agitation and deposition, and the carbonate of lime has been removed by weak acids, we examine the finer terrene substance which has resisted the weak acids, we find that it is not alumina, as Chaptal indicates, nor silica, as is stated in various works, but that it consists principally of veritable silicates of lime, of alumina, and of oxide of iron.

Still, it may be objected that these silicates are anterior to all vegetation; that to prove their recent formation and daily production, requires direct experiments. These direct experiments are among the objects which I wish to undertake. They require much time. But to prove truth, are we to depend solely upon new experiments peculiar to him who advocates it, and are we forbidden to rely on the labours of our predecessors? Certainly not. I may therefore again refer to the interesting researches of M. Becquerel, and bring into view those mineral species which he has formed in his laboratory, and which present all the characters of their natural congeners.

* Animal manures may contribute to the decomposition of silicates, not only by the carbonic acid which they form by absorbing oxygen from the air, but in producing such substances as the *fat acids*, which have a tendency to unite with lime and to eliminate the silica which is combined with it. M. Raspail, whose talents we are glad to acknowledge, without sharing in all his scientific opinions, appears to us to have explained the siliceous petrefactions that are found in chalk, in a very happy manner by the action of animals entombed in silicco-calcareous beds. (Physiol. Vegetale t. 3. p. 339.)

Neither can I omit to mention the important fact of the artificial formation of feldspar by Cagnard de Latour.

There is still another objection which may be made to the theory now presented. If in this mixed state, the earth acts by virtue of electro-chemical forces, why are three earths requisite to the construction of a good soil? Ought not silica and lime, or lime and alumina to be sufficient to produce, in each element of the mixture, an opposite electricity? It is easy to answer this objection also, by a reliance upon facts well known to mineralogists: it is certain that the binary silicates are more rare in nature than the ternary silicates, and that their mass in particular is less powerful: silica has therefore a greater tendency to combine with lime and alumina together than with either of these earths separately. Hence we may perceive that the union of the three becomes necessary to constitute a soil endowed with the highest degree of vegetative power.

If the ideas which I now submit to the Academy appear to deserve any attention, I propose, on the return of the favorable season to renew the enquiry, and to devote myself to the labour of positive experiment,—experiments, which, whatever may be their results in reference to my theory, will at least have the advantage of eliciting facts which may be friendly to agriculture, that science which is so prominently stamped with the character of utility.

Jour. de Pharmacie.

Indications of Organic remains in the oldest Rocks of the Globe; means of distinguishing Trap from Basalt; By Henry Braconnot.

The author examined some specimens of Trap from the neighbourhood of Essey, in the south of the department of La Meurthe, a region which had been considered by some naturalists as volcanic, although neither crater, lava nor scoria was to be found in it. Some prisms of blackish basalt are indeed obtained there, but it is well known, he remarks, that certain traps are found under geological conditions which forbid all idea of volcanic action. This pseudo-primitive form is due to the shrinking which the rock undergoes in drying. To determine whether these prisms from Essey had undergone the action of fire, he resolved to compare them with true volcanic basalt. He subjected to distillation, in a small glass retort, some of the Essey basalt, pulverized, and obtained from it an empyreumatic, ammoniacal product, which restored the blue colour of paper reddened by tournesol. The residuum of the distillation had a deeper shade than before, so that the carbon seemed to have been more exposed. Various other genuine traps from different places were in like manner powdered and distilled, and furnished absolutely the same product as the first.

From these facts he infers, that all these enormous masses of Trap which are found in the chain of the Vosges and in other places, have been formed in water under the influence of moderate temperature, and that prior to their formation the remains of organized beings were intimately mingled with the other elements of which they are constituted.

He next examined true basalt, which had incontestibly undergone the action of subterranean fire. A portion from Clermont in Auvergne was heated to redness in a glass tube closed at one end, and in which a strip of paper reddened by litmus was placed. Instead of changing to blue, as had been the case with the traps, no change took place; which shews that the organic substance which may be presumed to have existed among the materials of basalt before its formation, was destroyed by the volcanic fire.

By this test the author thinks volcanic basalts may be easily distinguished from traps, and that it may put an end to the discussions which still divide geologists, and banish the confusion which prevails in the determination of the rocks called *Basaltes.*

This unexpected discovery of animal matter in trap rocks, regarded by some geologists as contemporaneous with granite, induced him to examine that also. Some ancient granite, enclosing porphyroidal eurite was heated nearly to redness in a glass tube with reddened litmus paper, which very soon changed to blue. A slight odour appeared which was somewhat empyreumatic, though much less decided than in the case of the traps. Another specimen of ancient granite gave a similar result, and Egyptian sienite from the collection of M. Haldat yielded an ammoniacal odour on distillation.

"I conclude from these facts, that rocks regarded as forming the centre of the terrestrial globe, or at least as the nucleus of primitive mountains, include vestiges of organic remains, and that, however their formation may be explained, it has not taken place at a high temperature. I have also examined in the same way, several ancient rocks nearly contemporary, such as green porphyry and serpentine, which, like granite, gave a product scarcely empyreumatic and restored the blue of tournesol. Some granitoid amphibole from Tillot, (Vosges,) yielded an aqueous ammoniacal product of an odour decidedly empyreumatic, which seemed to indicate a formation less ancient than granite. Gneiss from Mybury, in Saxony, gave an acid which acted on the retort, apparently fluoric acid.

Some spotted sand-stone from Vosges, collected at the surface of the ground, furnished no signs of organic matter. Further extension might be given to these enquiries, but the facts here stated appear to me sufficient to change, or modify, our different hypothesis of the origin of rocks and the state of the globe at the epoch of their formation. Ann. de Chem. et de Phys.

Changes of Temperature which our Globe has undergone; by M. L. Agassiz.

In a very interesting discourse on the Glaciers Moraines, and erratic Blocks of the Swiss Mountains, delivered at the opening of the Helvetic Natural History Society, at Neuchatel, on the 24th of July, 1837, by its President, M. L. Agassiz, an account is given of the phenomena of the changes produced by the agency of Glaciers in remote periods, especially on the southern slopes of the Jura; to account for which the celebrated author adopts a theory of temperature quite new, it is believed, in Geology, notwithstanding the fertility which has characterised the opinions of those who have written upon this subject within a century or two past.

It is well known to those who have visited the Alpine regions that the Glaciers, or immense bodies of ice, which fill up more or less of the intervening space between the ridges that exist on the sides of the mountains, push along in their descent masses of stones and rubbish which collect on their sides like winrows, and which are known by the name of *Moraines.*

But it is not so well known that ancient *Moraines* are to be seen at various successive heights, both upon the Jura and the Alps, forming walls which follow the sinuosities of the sides of the valleys. Many stages of them are seen, some of which are some hundreds of feet above the bottom of the upper valleys of the Alps, where Glaciers now no longer exist.

Some there are which are quite distinct at a height of two thousand feet above the valley of the Rhone, above its entrance into the lake of Geneva.

A striking phenomenon also is the polished appearance of the surface of the rocks over which these ancient Glaciers have passed, evidently produced by the abrasion of the stones and gravel which have been urged along by them. Traces of these former Moraines may be followed even to the margin of the lake of Geneva. Whole sides of the valley of the Rhone are thus polished to the very shores of the lake, evidently produced by great masses of ice, which in former times have filled the bottom of all the Alpine valleys. Their polished surfaces, (denominated *laves* by the mountaineers,) are formed on the southern slope of the Jura, which fronts the Alps, to its very summit.

Moraines are witnessed on the very margin of the lake of Geneva, and on both banks, at the same elevation, rendering it certain, according to Agassiz, that there was a time when the lake was frozen to the bottom, and when the ice was elevated to a considerable height above its present level.

On the southern slope of the Jura are also large blocks or boulders of Granite which must have come from the Alps, some of which are of the size of 50,000 cubic feet. These are usually less rounded and are even of a larger size than those which are found in the Moraines at the margin of the existing Glaciers. These large angular blocks repose on small blocks, or pebbles, rounded by attrition and these again rest upon smaller, which pass below even into a fine sand, lying immediately over the polished surfaces of the Jura rocks.

The removal, or transportation, of such boulders has been very generally attributed to vast currents of water, or to floating ice. But the insufficiency of this theory appears very evident from the order of superposition, which is constantly opposed to all idea of a transport by currents. To account satisfactorily for the existence at once of these ancient *Moraines*, of the unpolished surface of the sides of the valleys, and of the order of superposition, is the great object in question. I must give the theory of President Agassiz in his own words, as I find it in a translation of his discourse in *Jameson's Edinburgh New Philosophical Journal.* G.

I shall now proceed to that explanation of the phenomena which I consider the most plausible; and which is the result of my own views, together with those of M. Schimper, upon the subject. In glancing at many general questions which are connected with the explanation, I have no intention of expatiating upon them. I wish simply to demonstrate that the subject now before us has a relation to the most interesting and important geological inquiries.

The study of fossils has for some time led to very unexpected results, especially since it has assumed a physiological character; that is to say, since it has been recognised, that a progressive development exists in the whole range of those organized beings which have formerly peopled the earth; and since epochs of renewal have been recognised throughout the whole. Those individuals who have admitted this progression ought not now to entertain any fears in prosecuting these consequences to their legitimate limits; and the idea of a uniform and constant diminution of the earth's temperature, such as is now sometimes admitted, is so contrary to every physiological idea, that it must be strenuously repelled, to make way for another, viz. that there has been a diminution of tem-

perature, which has been accidental in relation to the development of the organized beings that have appeared and disappeared one after the other at determinate epochs, maintaining itself at a particular mean temperature during a giving era, and diminishing at certain fixed epochs.

As the development of individual life is always accompanied with that of heat, since its continuance establishes a certain equilibrium of longer or shorter duration, and since its extinction produces an icy coldness, I conceive I deduce only legitimate inferences, when I conclude that the same phenomena occurred upon the globe: that the earth, when it was formed, acquired a certain very elevated temperature, which progressively diminished during the different geological formations; that during the continuance of each of them, the temperature has not been more variable than that of our globe since it has been occupied by its present inhabitants, but that it has been at the epochs of the disappearance of these inhabitants that a fall in the temperature has taken place, and that this fall has been beneath the temperature which prevailed in the subsequent epoch, and which re-appeared with the development of the newly animated creatures which were called into existence.

If this theory be correct, and the facility with which it explains so many phenomena which have hitherto been deemed inexplicable, induces me to believe that it is, then it must follow that there has been, at the epoch which preceded the elevation of the Alps and the appearance of the existing animated world, a fall of temperature far below that which prevails in our days. It is to this fall of temperature that we must attribute the formation of those immense masses of ice, which must universally have covered the surface, where we find these erratic blocks along with rocks which are polished as are ours. It is also, unquestionably, this extreme cold which has enveloped the Siberian mammoths in ice, has congealed all our lakes, and accumulated the ice as high as the ridges of our Jura, which existed before the elevation of the Alps.

This accumulation of ice above all the hydrographic basins of Switzerland may easily be supposed, on reflecting that when lakes are once frozen to the level of their emerging current, the running waters no longer drain off, and those of the atmosphere, augmented by the vapours of the southern regions, which under the circumstances, abundantly precipitate themselves towards the north, must have most rapidly augmented the extent, and raised the level even to the height which has already been established by the foregoing facts. The winter of Siberia was for a time established upon a soil previously covered with luxuriant vegetation, and peopled with great Mammalia, whose fellows in our day inhabit the warm regions of India and Africa. Death enveloped nature in its winding-sheet, and the cold reaching its extremest limit, gave to this mass of ice, at the maximum of tension, the greatest hardness it could acquire. When any one has frequently witnessed the congelation of a lake, he can then form a conception of the vast resistance of ice in this condition, and to what immense distances hard bodies which are thrown upon its surface may glide in consequence of even a feeble impulse.

The appearance of the Alps, the result of the greatest convulsion which has modified the surface of our globe, found its surface covered with ice, at least from the North Pole to the shores of the Mediterranean and Caspian Seas. This upheaving, by raising, breaking, and cleaving in a thousand ways, the rocks which compose the prodigious mass that now forms the Alps, at the same time necessarily raised the ice which

covered them; and the debris detached from so many deep upbreakings and ruptures, naturally spreading themselves over the inclined surface of the mass of ice which had been supported by them, slid along the declivity to the spots where they were arrested, without being worn or rounded, since they experienced no friction against each other, and even when arrested came in contact with a surface so smooth; or after being stopped, they were conveyed to the margin, or to the clefts of this immense sheet of ice, by that action and those movements which characterise congealed water when it is subjected to changes of temperature, in the same manner as the blocks of rock which fall upon the glaciers, approach their edges in consequence of the continual movements which the ice experiences, in alternately melting and congealing at the different hours of the day and seasons of the year. These effects ought to be described in detail; but as they are partly known I shall not dwell upon them.* I shall only remark, that the power of the action, so far as the ice is concerned, is immense; for these masses, continually moving upon each other, and on the surface, bruise and grind down every thing movable, and polish the solid surfaces on which they repose; at the same time that they push before them all that they encounter, with a force which is irresistible. It is to these movements we must attribute the strange superposition of rolled pebbles, and of sand which immediately repose upon the polished surfaces; and it is unquestionably to the grating of this sand upon these surfaces that the fine lines which we find are owing, and which would never have existed if the sands had been acted upon by a current of water; for neither our torrents, nor the stormy waters of our lakes, produce any thing like this upon the very same rocks. As to the longitudinal direction of these fine lines, and of the furrows which are observed upon the polished surfaces, it ought to be observed that they must have resulted from the much greater facility which the ice had in dilating itself in the direction of the great Swiss valley, than transversely, confined as it was between the Jura and the Alps; the phenomenon itself commencing only with the retreat of the ice, at the time that the Alps appeared. I have not the slightest doubt that the greater number of the phenomena which have been attributed to vast diluvial currents, and in particular those which M. Seefstrom has recently made known, have been produced by ice.

Upon the elevation of the Alps, the surface of the earth would be reheated, and the caloric disengaged on every side would produce the melting of the ice, which would gradually retire into its present domain. Clefts would first be formed in those places where the ice was thinnest, that is to say, on the summits of the mountains and the hills which were covered by it, afterwards upon the most saliant parts of the plain; valleys of drainage would then be excavated at the bottom of these clefts, in localities where no current of water could flow without being inclosed within congealed walls; and when the ice had completely disappeared, the great angular blocks which had covered its surface, or had fallen into the clefts, would be found upon a bed of small rounded pebbels, under which is usually found a layer of sand. In melting from the surface, the ice must necessarily have continued longest in the depressions of the country, in the little longitudinal valleys which are formed by the dif-

* M. Schimper has written a most interesting work upon the effects of ice, to which I should have been most happy to refer if it had been published.

ferent zones of the strata of the Jura, and at the bottom of the lakes; and it is undoubtedly to this circumstance we are to attribute the extraordinary position occupied by so many of these blocks, which are perched up, scarcely in equilibrium, upon the highest points of rocks; and also their constant absence in the hollows, where they are not found, except, at least, where fresh momentary expansions of the ice were able to precipitate them.

So long as the level of the ice on the Jura had not fallen below the line of Pierre-à-Bot, the blocks which were yet spread over its whole surface, might continue their descent towards the Jura; but so soon as the ice became thin over the plain of Switzerland, it must have very speedily disappeared, and have only left portions in the deep valleys, and in the basins of the lakes, that is to say, it must have been soon confined to the lower valleys of the Alps.

In reflecting upon what must necessarily have occurred upon this disappearance of the ice, we are naturally led to think that the transport of the rolled pebbles of the valley of the Rhine, and the deposition of *Löss*, must have been among its first effects; and this is confirmed by the facts, that these pebbles are the same with those which we found along with our blocks, and that the *Löss* is evidently the result of the detritus of the *molasse*. The frequent *débâcles* of the ice could only at that time convey blocks upon the masses of ice to great distances, or carry them farther in their current.

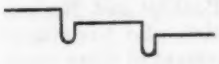
The melting and maceration of the ice and its repeated congelation in cold weather have produced many other geological effects, which it is difficult to account for as produced by any other causes. Without again recurring to the valleys of drainage or erosion, I may mention those deep furrows which are not fissures, and which have above them plains of great extent; also those small lakes which are sometimes formed near the edges of the glaciers, and which so affect the small stones that are accumulated at their margins, as to impress upon them the appearance of stratification; or again, the analogous phenomena which are observed upon the limits of different stations where the immense sheets of ice have successively stopped in their retreat; and likewise the dispersion of the bones of the Mammalia at the diluvian epoch, without their being at all rolled or broken, and in short, a number of other particulars which have no interest except when we embrace the whole of the question.

From this moment the surface of the earth must have been afresh subjected to the influence of the regular succession of the season. Then appeared the first spring time of the animals and plants which flourish in our days. The ice had retired to the foot of the Alps, and from their summits it began to receive fresh reinforcements. Speedily it reached its last retreats, where it is ever oscillating, sometimes gaining in extent, and forcing the blocks before it, and sometimes again retiring within narrower and narrower limits. At each step of ground they abandoned they left behind them, as the existing retreating glaciers now do, some of those long dykes of blocks which still exist in the Alpine valleys. Soon, too, the lakes themselves would melt, the waters would assume their present courses, the valleys of the Alps would be drained, and there remained no more ice, the product of former congelation, except on the summits of snow-clad mountains.

It would be a great mistake, therefore, to confound the glaciers which descend from the summits of the Alps with the phenomena of the epoch of that extensive ice which had preceded their existence.

The phenomena of the dispersion of erratic blocks, then, ought not any longer to be regarded in any other light than as one of the circumstances which have accompanied the vast changes occasioned by the fall of the temperatures of our globe previous to the commencement of our epoch.

The admission of an epoch of cold, which was so intense as to cover the earth to such distances from the pole with so vast a mass of ice as we have been contemplating, is a supposition which appears in direct contradiction with those well known facts, which shew a considerable cooling of the earth since the most remote period. Nothing, however, has proved that this refrigeration has been constant, and that it has occurred without oscillations. On the contrary, whoever has been in the habit of studying nature in a physiological point of view, will be much more disposed to admit that the temperature of the earth has been maintained, without any considerable oscillations, to a certain degree, during the whole period of any geological epoch, as is occurring in our own epoch, since it has diminished suddenly and considerably at the termination of each epoch, a change accompanied by the disappearance of the organized beings which characterized it, that it may rise again with the appearance of a new creation at the commencement of the following epoch, although at a lower degree of mean temperature than the preceding one, so that the diminution of the temperature of the globe may be expressed by the following line:—



Thus, the epoch of extreme cold which preceded the present creation, has only been a passing oscillation of the temperature of the globe, somewhat more considerable than the periodic refrigeration to which the valleys of our Alps are subject. It was attended by the disappearance of the animals of the diluvian epoch of geologists, as the mammoths of Siberia still attest, and preceded the uprising of the Alps, and the appearance of the animated nature of our day, as is proved by the moraines, and the presence of fish in our lakes. There was thus a complete separation between the existing creation and those which have preceded it; and, if the living species sometimes resemble in our apprehension those which are hid in the bowels of the earth, it nevertheless cannot be affirmed that they have regularly descended from them in the way of primogeniture, or, what is the same thing, that they are identical species.

By prosecuting these views, we may anticipate that the time will come when we shall be able to determine the geological period at which the sun began to exercise an influence upon the surface of the globe, so considerable as to produce the differences which now exist between the different zones, without these effects being neutralized by the influence of the internal heat, from which the earth must for a time have enjoyed a very uniform temperature over all its surface.

This theory, I fear, will not be adopted by a number of our geologists, who have settled and confirmed opinions on the point; but I anticipate it will be with this question, as with many others which assail old and established views. At all events, whatever opposition it may experience, it will remain true that the numerous new facts relating to the transport of blocks which I have pointed out, and which may be studied so easily in the valley of the Rhone and the environs of Neuchatel, have brought the discussion into wholly different ground from that on which it has hitherto been debated.

When M. de Buch for the first time affirmed, in opposition to the formidable school of Werner, that granite is of Plutonic origin, and that the mountains had been uplifted, what did the Neptunist say? At first he sustained his position alone; and it has only been by his defending it with the innate powers of genius, that he has made it triumph. It is happy for us, that in scientific discussion, numerical majorities at first have never decided any question.

The form into which I have thrown these observations will, I trust, banish all discussion on the subject at the present moment; and as, at the same time, I cannot hope that I have convinced every one of the truth of my views who have heard them for the first time, I propose the Geological Section as the most suitable for any discussion which may follow. I shall then make it my business to meet any objections which may be started; and, for the sake of truth, I earnestly solicit them.

Edin. N. Philos. Jour.

New Experiments on Light.

M. Arago read a note addressed to the Academy by M. Soliel, Jr., the object of which was to lay his claim to undoubted priority in all that relates to the construction of chromatic apparatus, intended to exhibit on a large scale the experiments of polarized rays of light through crystalline laminæ. For many years past, those philosophers who have paid particular attention to the optics of polarization, and among whom we will mention Messrs. Barbinet, Delezenne, Pelcet, Pouillet and Nœremberg, who have given their advice to this able artist, who has himself introduced many useful modifications in the arrangement of these experiments, which are so brilliant, and yet so little known. We ourselves can testify to the magnificent effects produced by these apparatus.

Last week, notwithstanding the inconvenience occasioned by the sun shining very dimly, Professor Pouillet exhibited these beautiful phenomena to the immense audience that is attracted to his course of natural philosophy. By the aid of this apparatus, which is both simple and reasonable in price, fifteen hundred persons were enabled to see and admire the system of admirable fringes produced by the interference of rays, an experiment attributed to Fresnel, and which is but a very happy modification of the colored rings of that master of all natural philosophers, Sir Isaac Newton.

The instruments of M. Soliel are equally adapted to the demonstration of the laws of double refraction, and of their identity with luminous polarization. By interposing crystalline laminæ in the path of rays, polarized by tourmaline, it exhibits on a large scale the brilliant complementary colours discovered in this case by M. Arago. This same crowd of spectators enjoyed the sight of the surprising results shown by crystals with one or two axes, which throw on a white screen, systems either circular, hyperbolic, or lemnisbates, curves tinted with a thousand colours, and of a brilliancy which no other process can even approach. Thus, all these magnificent images, obtained in France by Fresnel, Biot and Arago, and in England by Brewster, Herschel and Airy, are no longer cabinet phenomena, but may be exhibited to the most numerous assemblages.

We will add, that M. Soliel, jr., is not only the first who has made at Paris these beautiful apparatus, but he has discovered a very curious

effect produced by the dilatation of carbonate of lead on its optical axes and their superb curves. But these are things that must be seen to be appreciated, and all the descriptions in the world cannot give the slightest idea of the dazzling phenomenon of polarized optics.

We have been informed that our much esteemed fellow citizen, Professor A. D. Bache, was present at the experiment alluded to. Several specimens of M. Soleil's workmanship have been sent to this country, affording ample evidence of his ability, and we understand that Mr. Dobson, No. 108, Chesnut street, has received, and will continue to receive, orders for the apparatus made by him. Poulson's (Phil.) Daily Adv.

Progress of Civil Engineering.

On the comparative strength of the Cylindrical Tubes employed in high-pressure Boilers; with a plain practical rule for determining the relative strength of such tubes,—being in reply to a question of Mr. J. Hall in his letter to Mr. J. Seaward, of the 4th July, 1838.

To W. J. Hall, Esq.

(Copy.) Canal Ironworks, Limehouse, August 22nd, 1838.

Sir,—In your letter to me of the 4th July last, there was one question which I did not answer, viz., that respecting the difference of strength of plates employed in the construction of tubes: the reason of my not then replying to that question was, that it would have led into too much detail to be conveniently introduced in the then pending inquiry; the subject, however, being important, I now send you what I hope will be a satisfactory reply to your question. I also send you a few observations respecting the idea that steam boiler accidents are attributable to the explosion of gases. I propose to publish these documents, to which I presume, you can now have no objection.

I am, Sir, yours most obediently,

(Signed) John Seaward.

The strength of a cylindrical tube to resist an external pressure exerted on its outward surface, is a very different thing from the strength of the same tube to resist an internal pressure.

In the latter case, that is, when the force is exerted on the inside of the tube, and tending to burst or rend it asunder, the relative strength or power of resistance of the tube is very easily estimated; it is well known to be, under like circumstances, in the simple ratio of the thickness of the metal of which the tube is formed, and *inversely* as the diameter of the tube.

But in the other case, when the pressure is external, the strength of the tube to resist such pressure will depend upon very different principles:—it is generally supposed that the strength of a cylindrical tube under such circumstances must be immeasurably great; and there is no doubt that such is really the fact, provided the pressure is uniform all round the tube, and that the true cylindrical figure is strictly preserved; because in such case the tube is like a well-formed arch; it cannot be

destroyed except by the absolute crushing of the particles of metal one into the other, which is altogether improbable. But if the true cylindrical or circular figure is not preserved, and indeed if the deviation from the true figure of greatest resistance is ever so trifling, the principle of the arch is gone at once, it is then like an arch without abutments; and the tube under such circumstances, instead of being able to resist almost infinite pressure, will in fact be unable to resist a comparatively moderate pressure.

Now, practically speaking, it is almost impossible to form a tube that shall* be strictly cylindrical, or of any other figure of greatest resistance; the very weight of the material is sufficient of itself to destroy the true figure; the circumstance of the tubes of steam boilers being formed of metal plates with lap joints riveted together precludes the possibility of obtaining the true figure; moreover, in the case of horizontal tubes, as they are employed in steam boilers, the pressure is not uniform; for while the pressure on the upper part of a tube six feet in diameter may be only 13¾ lbs. upon the square inch, the pressure on the lower part of the tube will be nearly 16¾ lbs. to the square inch, because the weight of a column of water six feet high, has to be added to the pressure on the lower part of the tube; therefore the cylindrical, or circular, form is not in that case the true figure of greatest resistance; and it is not very likely that in the ordinary way of the business of boiler making, much care or correctness can or will be bestowed to the calculating, or afterwards in the making, of the tube, agreeably to the true figure of greatest resistance.

Moreover, if all the above difficulties be overcome, and the tube is formed according to the true figure of greatest resistance, there is little chance that it will long remain so, in the practical working of a boiler; the unequal contraction and expansion of the plates by being partially overheated and then suddenly cooled, accidents of constant occurrence, will cause the plates to be drawn and buckled, and thereby soon destroy the true figure. And it should be borne in mind that however trifling the alterations of form may be at first, yet the moment a slight alteration has taken place, the destructive change then goes on at an accelerated ratio. And here a very important distinction should be observed, which is, that when the force is exerted within a tube tending to burst it outwards, the force exerted will not induce any change of form such as to render the tube weaker; because if the tube was originally made tolerably near to the true figure of resistance, any change of figure which may afterwards take place, must be such as will render it in fact stronger—that is, supposing the metal plates to have some degree of elasticity—it will cause the tube to assume the figure of greatest resistance. But, it is not the same with a tube that supports an external pressure, because in this case, any change of figure must, demonstrably, produce a greater departure from the figure of greatest resistance, and thereby render the tube weaker and weaker; and this is a very important reason why a tube that has

* As a strong corroboration of this fact it may be stated that about fifteen years back some interesting experiments were made to ascertain the relative force which copper tubes were able to support internally and externally; the tubes were beautifully made, and as perfectly cylindrical as hands could form them, but it was found in every case that a much less force was sufficient to crush or collapse the tube than was required to burst it asunder.

been proved to a pressure of 30 or 40 lbs. to the square inch, may afterwards fail under a pressure of less than half that amount.

For the above reasons it is therefore clear, that a practical estimate of either the absolute or relative strength of tubes, supporting an external pressure, cannot be based upon the idea of these tubes being correctly formed agreeably to the figure of greatest resistance; the safe mode is to estimate the strength of the tubes by the capacity of the metal plates (of which the tubes are formed) to resist a transverse strain, in the same manner as we should estimate the strength of a flat plate, a bar, or a beam, the strength of which is known to be in the ratio of the square of the thickness or depth, in the direction of this strain.

Under this view of the matter, therefore, it would be correct to consider, that the strength of tubes under an external pressure would vary as the *square* of the thickness of the metal, but it is also clear that the strength will also vary *inversely* as the *square* of the diameter of the tube; because an increase of diameter not only increases the leverage, but also the absolute quantity of force in a like ratio.

But it would not be right to suppose that the absolute strength of curved plates in a tube is no greater than that of perfectly flat plates; this is not the case: there can be no question that the curved form enables the plates to sustain a much greater force than flat plates are able to support; and it is clear that the nearer the curvature of the plates approximates to the figure of greatest resistance, the greater force they will be able to bear; for although, as is stated above, the slightest deviation from the figure of greatest resistance destroys the principle of the arch, and thereby reduces the comparative strength of such tubes from almost infinity to a strength of very moderate limits, nevertheless curved plates will support a greater or less strain the nearer or the more remotely they approach to the true figure of greatest resistance.

It is therefore evident, that besides the capacity of resisting a transverse strain, there is another element of strength in tubes subject to external pressure; that is, the strength derived from the curvature of the plates; but, as this latter strength depends entirely upon the greater or less approximation of the curvature to the figure of greatest resistance, and as the degree of approximation will vary in every individual case, and will also be liable to rapid alteration in the same tube, it is clear that no general rule can be given for determining the strength thereby gained. And, indeed, this is not requisite in the present instance, because it is not intended to offer a rule for estimating the positive strength of tubes, but simply the relative strength of different tubes; which, as above stated, is, in like circumstances, as the square of the thickness of metal, and inversely as the square of the diameter of the tube. The positive or absolute strength of such a tube can only be known by actual proof, but this once known by the strength of other tubes may be estimated by the following rule :—thus, if a tube of 3 feet diameter and made of $\frac{1}{2}$ inch plate is capable of sustaining a given external pressure, what will be the relative strength of a tube 6 feet diameter made of $\frac{1}{4}$ inch plate? Answer—the former is 16 times stronger than the latter.

But, in the case of the force acting inside the tube with a tendency to burst or rend it asunder, the strength of the tube will be as the thickness of the metal directly, and inversely as the diameter; therefore, if a tube is 3 feet diameter, and made of $\frac{1}{4}$ inch plate, it will be 4 times as strong as a tube of 6 feet diameter made of $\frac{1}{4}$ inch plate.

The foregoing is a safe, easy, practical rule, and if employed by boiler makers in the planning of high-pressure boilers, I believe it will be the means of preventing many serious errors and fatal accidents.

Limehouse, August 20, 1838. JOHN SEAWARD.

Mech. Mag.

On the Cornish Engines. By THOMAS WICKSTEED, M. Inst. C. E.

In this communication, Mr. Wicksteed gives an account of several trials which he made on some engines in Cornwall. In a trial of the engine upon the Holmbush Mines, the water was delivered into a cistern and weighed, and the result obtained by an experiment was 102,721,323 lbs. raised one foot high with ninety-four pounds of coal: this was the quantity raised and delivered. The quantity raised does not, however, express the duty of the engine, which must be calculated according to the contents of the pumps and the atmospheric column, without any allowance for leakage. According to this calculation, the duty would be nearly 118 millions; namely, 117,906,962 lbs. raised one foot high with ninety-four pounds of coal.

Another calculation is then given, founded on the law of Boyle, that the pressure of the steam is inversely as the space occupied. The steam was cut off at one-sixth of the stroke, and the temperature in the jacket was fully maintained by free communication with the boiler. The mean pressure of the steam being (on the above law) 17.66 lbs. on the square inch, the power of steam would be 271,658,700 lbs. Now, as the duty would be 117,906,992, we have 93,751,710 for the friction of the machinery, or about $7\frac{3}{4}$ lbs per square inch; which is about two pounds more than the friction of a water works pumping engine.

Mr. Wicksteed also made trial of a double engine at the Tincroft Mines working stamps, cutting off the down-stroke at two-fifths, and in the up-stroke at one-third. The duty of this engine was 56,525,072.

The coals consumed by the Tincroft engines amounted only to 1.57 lbs. per horse power per hour; whereas, in an experiment at Oldford, the quantity was 4.82 lbs. notwithstanding the additional friction in the former case of the mining engine. The consumption is stated by Mr. Farey, in his Treatise on the Steam-engine, for a double engine (Boulton and Watt,) at $10\frac{1}{2}$ lbs. per horse power per hour.

At the end of the paper are two tables, the one showing the gradual improvement of the steam-engine during sixty-six years, and the other the average duty of engines in Cornwall, for 1835 and 1836. The improvement has been progressive from 1769 up to the present time; and it appears, on the authority of Mr. John Taylor, that on comparing the water raised and the coals consumed from 1799 to 1828, at different times, there is a saving on the books of the mines proportionate to the improvements stated to have been made during these periods in the working of the engine.

Some discussion took place on the weight of the bushel of coals, Mr. Lowe stating that he had never known a bushel of Newcastle coals to weigh more than 84 lbs. Mr. Price stated, that the Welsh coal, which was chiefly used in Cornwall, was very heavy, and he had known a heaped up bushel to weigh 101 lbs. The weight of the Newcastle coals was considered as varying from 80 to 84 lbs.

Jour. Arts & Sci.

Camus on the Teeth of Wheels.

May 4th, 1768, died Charles Stephen Lewis Camus, the celebrated French geometrician, aged 69; author of a well-known Treatise on the teeth of Wheels, in which the best forms to be given to them for the purpose of machinery, were for the first time determined, on true mathematical principles. An English translation of this treatise appeared in 1806, with some additions from the translator's own pen, which evinced an unfortunate ignorance of the scope of M. Camus' demonstrations; and have been a fruitful source of error in English mechanical practice. Camus proved clearly that the epicycloidal part of a tooth, designed to act on another wheel or pinion, ought to be generated by a circle equal to *the radius* of the wheel or pinion with which it is to be engaged; while his English translator represented his meaning to be, that it should be equal to *the diameter!* Mr. J. I. Hawkins, who has lately favoured the public with a more correct edition of the treatise, states, that "many of our first-rate engine manufacturers" have been so misled by this misconception of the original translator of Camus, that they are daily "pouring into the market multitudes of cast-iron wheels and pinions, of various magnitudes, for cotton and other machinery, with teeth formed from the epicycloid of the diameter, instead of the radius of the opposite wheel, or pinion," and which must, in consequence, "wear out in a few years, instead of lasting the greater part of a century,—as many of them would do, if the teeth were formed on true principles. We regret to learn, from the same authority, that there are many wheel-makers who follow no rule of proportion at all in their formation. "In Lancashire, they make the teeth of watch-wheels of what is called the bay-leaf pattern; they are formed altogether by the eye of the workman, and they would stare at you for a simpleton, to hear you talk about the epicycloidal curve. These Lancashire workmen should be called the bay-leaf fanciers, because they cannot be bay-leaf copiers; since it is notorious that there are not two bay-leaves of the same figure. It is the opinion of Mr. Hawkins, that teeth accurately formed, either by epicycloid or involute curve, will endure the wear of a century, with less damage than teeth, as usually made, suffer in ten years.—*Mechanic's Almanac.*

Mech. Mag.

An account of an immense Chimney, recently built at Carlisle; with Suggestions for applying Chimneys, or Cones, of immense Height, to scientific purposes. By P. A.

"The immense chimney attached to the new cotton factory, now being built for Messrs. Peter Dixon and Sons, in Shaddongate, had the last stone placed upon it on October 24, 1837. It is one of the highest buildings in England, being 305 ft. from the ground; and for the purpose to which it is to be applied, is understood to be the highest erection in the world. It may be distinctly seen for many miles in all directions around Carlisle, and forms a beautiful object in the view of our city, from which ever quarter you approach it. The building is of the octangular form, and is built with brick, the angles being formed of stone. The base, which is built with fire-bricks, is 17 ft. 8 in. in width inside, and the thickness of the wall at the foundation is 10 ft. It tapers upwards to a width, inside, of 6 ft. 3 in.; and on the outside 8 ft. 9 in. Near the top

there is a cornice of stone, 7 ft. in depth, which projects 3 ft., and above this there are 8 ft. 3 in. of brickwork, surmounted by a coping stone one foot in thickness. The cornice gives a finished and classical appearance to the building; and the whole would be taken for some splendid national monument, rather than a mere conduit pipe for smoke. It is not a little creditable to Carlisle, that this magnificent work was entirely executed by a native of that city, a builder, a Mr. Richard Wright, who has completed it in a way to give the most entire satisfaction to every scientific man who has examined it. Considering its immensity, the work was completed in an incredible short period of time. The foundation stone was laid on Sept. 11, 1835, by P. Dixon, Esq.; the first brick was laid by Mr. Wright, on Sept. 17.; the last course of bricks, also by Mr. Wright, on Oct. 22, and the last coping stone on Oct. 25, 1836; thus completing the work in thirteen months. The erection was carried on from the inside, stages being erected as the work proceeded, and the workmen and materials being taken up in boxes prepared for the purpose, by a crab worked by four men; and it is gratifying to add that the whole was finished without any accident occurring to any individual engaged in it. Agricul. Mag.

Transactions of Institution of Civil Engineers.

June 13, 1837.—The President in the Chair.

Warming and Ventilating.

Mr. Oldham resumed the account of his system of warming and ventilating, and exhibited a model of his stove for heating the air. He was convinced that the expedient of forcing the air by mechanical means must be resorted to. He had raised the temperature of a room 24° F. in one hour; by spontaneous ventilation he could never obtain a temperature of more than 100° F., but by pumping in the warm air he readily obtained a temperature of 150° F., or 180° F.

Light House Lamps.

Mr. Horne called the attention of the Institution to a lamp which he thought would be peculiarly applicable to lighthouses, or wherever an intense light is required. The usual burners are an inch in diameter: now he had succeeded in producing a clear white light by a burner of half an inch in diameter. The excellence of the light is due to the complete combustion obtained, by making the area of the external equal to the area of the internal apertures. The air thus passes directly to the burner; there is a perfect uniformity of draught, the rapidity of which may be regulated by the height at which the burner is above the bottom of the glass, or chimney. The draught of air being thus supplied with perfect equality to both sides of the wick, a flat and steady flame of two inches in height is obtained, and the force of the draught is sufficient to prevent the flame from touching the edge of the burner, so that the edge is always clean and fit for use. Jour. Arts and Sci

Mechanics' Register.

New Material to be applied to Dwelling Houses, to render them capable of resisting Fire.

About the middle of November, 1837, the scientific world was somewhat startled by observing, in the newspapers, an announcement that a discovery had been made and perfected, of a material to be applied to dwelling houses, capable of entirely resisting the action of fire; that an experiment was to be made to prove its efficacy, at White Conduit House, Nov. 25, 1837; and that the presence of all parties concerned was requested to view the exhibition. It might have been supposed that the answer to this appeal would have been universal; and, as parties generally attend where there is nothing to pay, and they really are interested, that half London would have been present on the occasion. But, unfortunately, John Bull has had "Wolf!" shouted to him so often of late, mighty discoveries have turned out "such fantastic tricks," that he has grown very sceptical indeed. There was, however, a tolerably numerous party collected at White Conduit House on the day of experiment; some, of course, interested in its success; others, perhaps, equally so in its downfall. The material is, in appearance, a cement, and, like it, may be applied with the trowel, or with a brush in the manner of paint. Mr. Dewitte, the inventor of this composition, considers that it should be applied to the timber of a house while building, about a quarter of an inch thick; or it may be employed instead of the common plaster now in use, as it can be worked with equal facility, and polished and painted the same. Sufficient quantity has not yet been prepared to form any certain estimate of the expense; but he considers that the cost of preparing the whole of the timbers of an 8 or 10 roomed house would not exceed 30*l.* or 40*l.* For the experiment, two little wooden houses had been constructed; the one prepared interiorly, with the exterior just washed over to show the nature of the composition, and the other left in its natural state. These were filled with shavings and fired: the one not prepared was, of course, immediately one mass of flame; while the other resisted every effort to ignite it. It was delightful, at this moment, to watch the disappointment of the oppositionists, who afterwards took an unfair advantage of a neglect on the part of the proprietors. When the burning mass of the unprepared house was at its greatest heat, they busied themselves to turn it round close upon the other building, though Mr. Dewitte assured them that the exterior of the building was not prepared. After some time it began to burn, and they gloried in their triumph, until the one building, having burnt itself out, dropped to the ground, and discovered the side of the other partially burnt away, but with the inside coating and the rest of the building as perfect and unharmed as if it had never been touched, notwithstanding the furnace heat that had been applied to both sides of it. The persons assembled, among whom were Mr. Barry, and other eminent architects and scientific people, declared themselves perfectly satisfied of the complete success of the material: the only hope expressed was to see the experiment tried on a larger scale, when the proprietors shall be better prepared for it. Convinced of its perfect efficacy and value, I trust they will imme-

diately set about preparing a more extensive trial, to prove to those who are so anxious to throw cold water on the invention, that it is of no more use in stopping their progress, than it would be in stopping the progress of the flames when we shall enjoy the security of having our houses prepared with their composition.—*A. December*, 1837. Arch. Mag.

Discovery of ancient Piece-Goods and manufactured Stuffs.

It is more than a thousand years since Theodolphus, Bishop of Orleans, gave to Notre Dame du Puy en Velay a beautiful manuscript, containing the ancient Testament, the chronography of St. Isidor, and other pieces, the whole distributed into 138 articles. He made this gift in gratitude for his deliverance from the prison of Angers, where he was confined in 835. It was on Palm Sunday that year, while Louis Le Debonnaire was passing, that he began to sing a well-known Canticle, which the Catholic church has since then introduced into its ceremonies. This precious manuscript, in a state of perfect preservation, is to be seen in the archives of the Bishopric of the Puy en Velay, department of the Haute Loire. A portion of the manuscript is written on leaves of common parchment, in letters of red and black, intermixed with some of gold. The other portion is written on leaves of parchment, dyed purple, with letters of gold and silver, among which are observed ornaments of different kinds and different colours, designated the Byzantine style. The manuscript, which is remarkable for its beauty and its preservation, is still more remarkable for the *manufactured stuffs* of different descriptions which it contains. When Theodolphus composed his manuscript, with the intention of preserving the gold and silver characters from contact and friction, which, in time, would have tended to displace and obliterate them, he placed between each page a portion of the manufactured tissues peculiar to the era when he lived. These examples of the silk, and other pieces of goods of the time are thus curiously preserved. Till lately, little attention was paid to these tissues, which are principally of India manufacture, and which bear scarcely any analogy to the products of the modern loom. Some are Cashmere shawls of those patterns, which the French call *broucha* and *espouline*, and made in the Indian fashion, but with this difference, that they are limited to four colours, and demonstrate the greatest antiquity by the primitive simplicity of their colours and design. Others are crapes and gauzes, against the luxury of whose transparent tissues, the fathers of the church at that time so perseveringly fulminated their censures. The rest consist of muslins and china crape of exquisite beauty. The components of the majority of these tissues consist of goats' or camels' hair of exceeding delicacy and fineness. Like the manufactured stuffs of ancient Egypt, painted on the walls of its palaces and tombs, or substantially preserved amidst the envelopes of mummies, the designs are limited to four colours, which are in fact the four sacred colours of China, India, Egypt, and the Hebrew Tabernacle. Nevertheless, the Egyptian designs, which are identical with those of India, are many of them of exquisite beauty. The consummate skill of the silk and cotton manufacturers of ancient Egypt, 4000 years ago, the beauty and richness of their fabrics—and the little alteration which has taken place in the economy or machinery of the factories, as well as in

their product, has been recently demonstrated in the great work of Champollion. All the details of the silk and cotton factories of Egypt, under the Pharoahs of the 18th dynasty (which then monopolised the commerce of the world, and which sent a colony of weavers, from the overburthened population of Lower Egypt, to found Athens, and the subsequent civilization of Europe and this country) are laid open with vivid accuracy in that splendid work, and brought with all their startling analogies before the eye of the modern reader by the drawings from the temples, palaces, and tombs which it contains. It proves, indeed, that there is "nothing new under the sun." Mining Rev.

Probable duration of English Coal Beds.

In the fifth edition of Mr. Bakewell's *Introduction to Geology*, just published, there are some remarks on the duration of English coal, in addition to the observations made in the former editions of the work, which were quoted in evidence given on the subject in a committee of the House of Commons. After noticing the report of the committee, which estimated the annual consumption of coal in Great Britain at twenty-two millions seven hundred thousand tons, Mr. Bakewell proceeds to observe:

"The increasing demand for coal in the iron furnaces, and for steam navigation and steam carriages, will probably soon raise the quantity of coal annually consumed to thirty millions of tons, without adding to this ten millions of tons for coal left and wasted in the mines. A better idea of the consumption of coal will, perhaps, be formed by stating the quantity of coal burned in the furnaces of one house only (Messrs. Guest, of Myrther Tydvil, in Glamorganshire,) which is 970 tons per day, or 300,000 tons yearly; the amount of iron produced is 50,000 tons. This is a larger quantity of iron than was made by all the furnaces of Great Britain and Wales in the year 1760, and exceeds the quantity of iron at present made in Scotland, which in 1827 was only 36,500 tons. Surely when such an immense quantity of coal is required for domestic use and manufactures, it cannot be wise to encourage, or even to admit, the export of coal to foreign parts. The coal so exported, exclusive of that to Ireland and the colonies, is 500,000 tons annually. The duty on exported coal was entirely taken off in 1835, to satisfy the great landed proprietors in the north of England. I have before stated that the coal in Northumberland and Durham would at the present rate of consumption be exhausted in 350 years. An agent of one of the northern proprietors, in his evidence before the House of Commons, extended the duration of the northern coal fields to 1,727 years, estimating that there remained 732 square miles of coal in Northumberland and Durham still unwrought, and that the average thickness of the coal is twelve feet. In this calculation it seems to have been assumed that each workable bed of coal extends under the whole coal field, but many of the best and thickest beds of coal crop out long before they reach the western termination of the coal districts, or are cut off by faults or denudations. Professor Buckland, in his evidence on the subject, estimates the duration of the coal at the present rate of consumption to be 400 years. Professor Sedgwick, who is well acquainted with the coal strata of Northumberland and Durham, and had examined persons of great experi-

ence, gave his opinion respecting the duration of the coal in these counties as follows :—'I am myself convinced that with the present increased and increasing demand for coal, 400 years will leave little more than the name of our best coal seams;' and he further adds, 'our northern coal field will probably be on the wane before 300 years have elapsed.' "

Mr. Bakewell concludes his remarks on this subject by observing that his former anticipations, that improved methods of burning coal would be discovered, have been realised to a great extent; in proof of which he alludes to statements made at the last meeting of the British Association at Liverpool, of the use of the culm or dry coals of South Wales, by employing the hot blast, in smelting ironstone, which coal it had formerly been attempted to use for that purpose without success. "If," continues Mr. Bakewell, "the use of the hot blast is found everywhere to succeed, the consumption of coal in the iron furnaces will be reduced one half. It may, however, be doubted whether this reduction will equal the increasing demand for coal for steam-vessels and rail-road carriages, and the various manufactures of Great Britain." Farmer's Mag.

Steam Coach.

A few days since, Dr. Church's steam-coach went to Coventry with an omnibus attached to it, loaded with passengers, at the rate of twelve miles per hour. It ran up the hills at the rate of eight miles an hour. It came back with twenty-three passengers (three ladies,) without any accident. On Friday it proceeded to Meriden and back, also with an omnibus and passengers, and without accident. It will go to a more distant town early this week.—*Birmingham Gaz.*

On the Adulteration of Carmine; by C. G. Ehrenberg.

There occurs in commerce a kind of very fine coloured and very expensive carmine in the form of cakes, which owes its fine colour to an adulteration. Upon being made use of for ordinary painting no difference has been observed, but by the microscope it may be discovered that half of it consists of starch (wheat starch) which imparts to the finely divided carmine a clear ground and a brilliancy highly improving the appearance of the colour. When such carmine is mixed with much water, it diffuses itself throughout, and is for a long time suspended; but upon pouring off the water a white sediment remains similar to white lead. The sediment is starch. Besides this distinct form and size of an amilaceous body, when it is examined by its reaction upon tincture of sodium, it produces the well-known blue colour. This sediment when heated with water forms a paste. The addition of white lead is detected by its weight, but the addition of starch is not so easily discovered; but by means of the microscope the adulteration may be with certainty recognised, and confirmed by chemical examination. It may perhaps be interesting to the artist to know that few colours of this description mixed without an organic body, although pretty generally permanent, that are not in a damp atmosphere very liable to decomposition. In regard to its covering properties, starch differs considerably from white lead. It covers less on account of its transparency.—*Poggendorff's Annlaen, No.* 12, 1837. Lond. & Edin. Philos. Mag.

Pin-making.—Triumph of Machinery.

At Messrs. D. F. Taylor and Co's patent solid-headed pin manufactory, near Stroud, the machinery simultaneously performs the various functions, with little noise or effort while converting the rings of wire into pins, without the instrumentality of any manual assistance whatever; for while one combination of the machine is drawing forward, and straightening the wire, and cutting it to the required length, another apparatus is forming and smoothing the point, a third compressing and shaping the head, and a fourth detaching and drawing out the pin in its finished state, which falls into a receiver prepared for it; thus forty-five pins per minute are made by machines, while the whole plant is producing the almost incredible number of three millions two hundred thousand pins daily, exceeding nineteen millions weekly throughout the year. Mining Jour.

Number of Patents in France.

It appears, from authentic documents, that the following number o patents for inventions and improvements was granted in France from the 1st of July, 1791, the period at which they were first accorded, to the 1st of January in this year. The account is divided into the following periods:—During the Constitutional Monarchy, which lasted but three years, 67 patents were granted; during the Republic (fourteen years) 301; during the Empire (eight years) 606; during the Restoration, (sixteen years) 3383; during the Monarchy of July (seven years) 3018; total during the whole period 7375. Ibid,

---

Raising a large Stone in the River Tay.

An immense stone, long supposed to be a rock, and imbedded in the fairway of the channel, the top of it being immersed to the depth of five feet at low water, has been lately removed from its situation by operations continued during only five tides. The stone, of which the solid contents were 598 cubic feet, and the weight between forty and fifty tons, was raised by means of two dredging lighters, capable of containing twenty-five tons each, which were brought to the spot at low water. A hole of two inches diameter was previously made in each side of the stone, and plug-bats having been inserted, a chain was fastened to them, and thus when the tide rose, the stone was floated off its bed and conveyed ashore. Ibid.

Preserving Scythes, &c., from Rust.

To preserve scythes, sickles, reaping hooks, and other steel tools from rust after the season for using them, wipe them clean and dry, and hold them before the fire and keep drawing them backwards and forwards until warm enough to melt wax; then take some bees' wax and rub it all over. A halfpenny worth of wax will be sufficient for a scythe. Then put it in a dry place, but not warm; it needs no other covering. The usual method is to wrap a hay-band round; but in winter time this naturally contracts moisture, or the damp air strikes in betwixt the folds of the hay-band. Farmer's Mag

LUNAR OCCULTATIONS FOR PHILADELPHIA, JANUARY 1839.

Angles reckoned to the right or westward round the circle, as seen in an inverting telescope.
☞ For direct vision add 180° ☜

Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
21	6	20	Im. π Piscium	6	70°	90°
21	7	3	Em.		1	32
26	8	12	Im. 49 *c* Aurigæ	6	79	24
26	9	34	Em.		279	253
26	11	18	N. App. ☽ & 54 Aurigæ 6, ☽ S. 1.′9			
27	13	46	Im. *c* Gem.	6	117	174
27	14	31	Em.		197	256
28	16	10	Im. γ Cancri	5	28	84
28	17	2	Em.		276	331
30	8	19	Im. 34 Leonis	6	21	329
30	9	5	Em.		293	241

Meteorological Observations for July, 1838.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	70	80	29.80	29.85	E SW.	Moderate.	.2	Cloudy—showery.
	2	70	85	85	90	S.W.	do.		Cloudy—lightly cloudy.
	3	72	88	85	63	W.	do.		Clear—do.
	4	70	90	80	80	S.W.	do		Clear—do.
	5	74	91	80	80	S.W.	do.		Foggy—clear.
	6	72	83	90	90	N.W.	Brisk.		Clear—do.
☉	7	66	88	90	90	W.	Moderate.		Clear—do.
	8	71	89	90	90	W.	do.		Clear—do.
	9	74	92	86	86	W.	do.		Clear—do.
	10	78	94	80	86	W.	do.		Clear—do.
	11	78	92	75	75	W.	do.		Clear—flying clouds.
	12	74	85	75	80	N.W.	do.	.20	Clear—rain.
	13	64	78	90	30.00	N.E.	do.		Cloudy—clear.
☽	14	68	85	30.15	15	W.	do.		Clear—flying clouds.
	15	65	86	.05	00	S.W.	do.		Clear—do.
	16	68	88	29.85	29.80	S.W.	do.		Clear—do.
	17	74	86	85	85	W.	do.		Clear—do.
	18	71	87	95	95	S E.S.	do.	.39	Flying clouds—rain.
	19	74	86	85	85	W.	do.		Clear—lightly cloudy.
	20	76	92	95	80	W.S.W.	do.		Flying clouds—do.
⊗	21	79	87	70	70	W.N. W.	do.		Flying clouds—do.
	22	63	75	90	90	N N.E.	do.		Flying clouds—do.
	23	60	78	30.00	30.00	S W.	Calm.		Clear—flying clouds.
	24	61	77	00	00	S.W.	do.		Cloudy—do.
	25	67	84	29.80	29.80	S.W.	do.		Flying clouds—do.
	26	69	84	80	80	N.N.W.	do.	.48	Cloudy—fly. cl'ds.—rain in n'gt.
	27	74	88	85	85	S-W.	do.		Clear—do.
	28	72	93	90	90	W.	do.		Cloudy—do.
☾	29	77	92	88	80	W.	Brisk.		Clear—do.
	30	75	92	70	70	W.	Calm.		Clear—do.
	31	70	84	80	80	W.	do.		Clear—flying clouds.
	Mean	70 52	86.42	29.86	29.86			1.09	

	Thermometer.	Barometer.
Maximum height during the month.	94. on 10th.	35.15 on 14th.
Minimum " " "	60. on 23d and 31st.	29.63 on 3d.
Mean	78.49	29.86